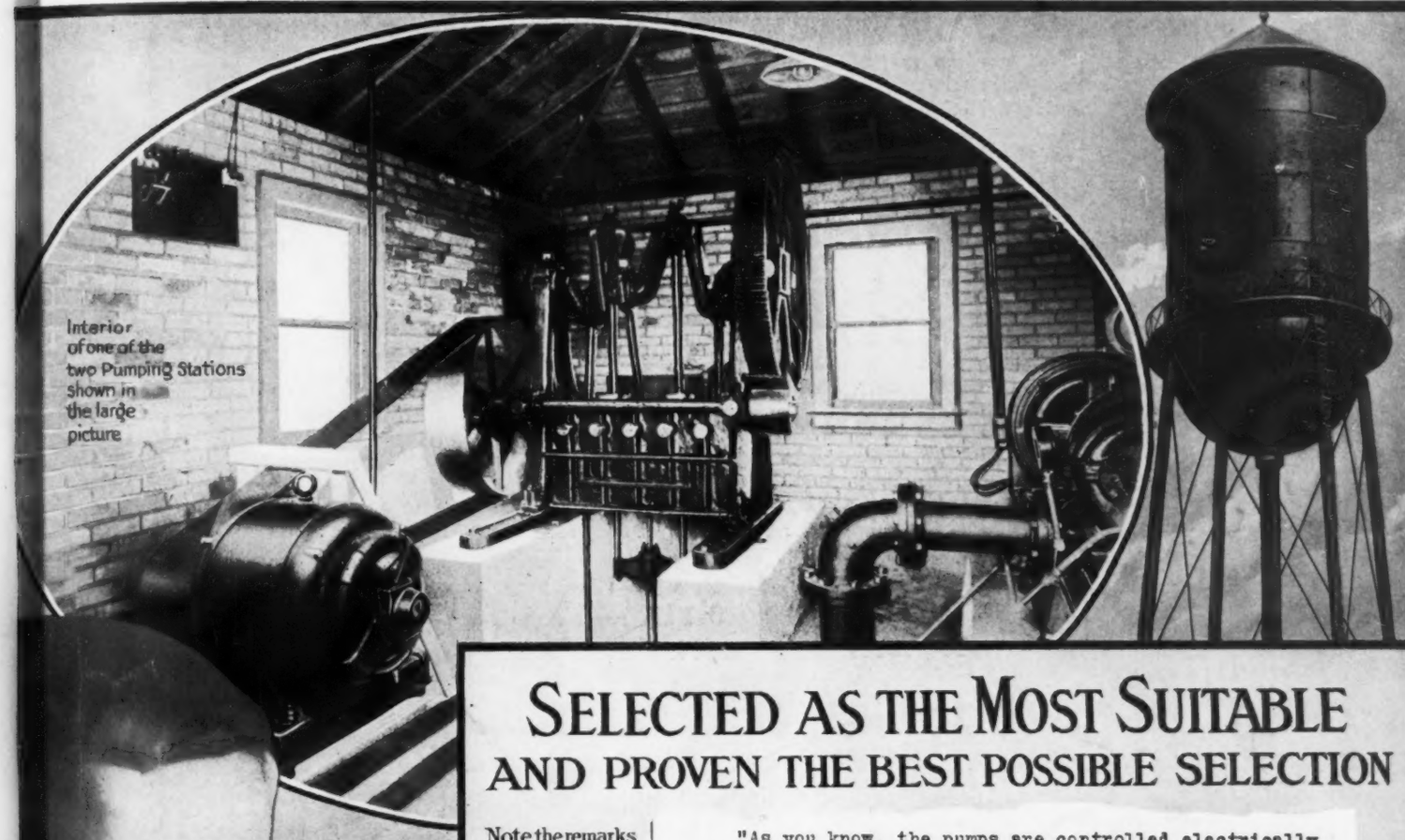
Engineering Training and Experience—the Analysis of the Qualifications of Candidate for Electrical Engineering Position

AUG 20 1917
UNIV. OF MICH. LIBRARY
Engineering Library

Electrical World

New York, August 18, 1917 McGraw-Hill Publishing Co., Inc. Vol. 70, No. 7 10c a copy



Interior of one of the two Pumping Stations shown in the large picture

SELECTED AS THE MOST SUITABLE AND PROVEN THE BEST POSSIBLE SELECTION

Note the remarks of the contractor to the pump manufacturer concerning this installation of Wagner Motors for the City of Zeeland, Mich.

"As you know, the pumps are controlled electrically, so there is no operator in charge. The electrical apparatus starts and stops the motors to drive the pumps as the demand for water is made. I feel that since this equipment has been in operation -- nearly a year -- a letter to you, in regard to the satisfactory manner in which the pumps have worked, would be in line. We have had several letters from the young man in charge of the station, and in every letter his report has been the same -- that the machinery was in every respect as we had left it, and operating satisfactorily."

These are Wagner BW (Self-starting) Type, Polyphase Motors. The starter is on the inside and automatic. Ideal for remote and automatic control. When started by hand a single-throw switch is all the starting device necessary. If you have need for power service of this kind, investigate Wagner, Quality BW Motors. Send for Bulletin No. 111 and Booklet, "A Motor for Every Pump."

Wagner Electric Manufacturing Company, Saint Louis, Missouri

Water Plant installed for City of Zeeland, Mich.

Study the Instrument Question

Only when you have studied it by direct comparisons will you realize fully what a high degree of efficiency and economy you can effect by selecting

Weston

Indicating Electrical Measuring Instruments

As soon as you inspect them—even before you subject them to the test of comparison in actual use—the reasons for their acknowledged superiority will be apparent to you. These reasons are revealed in every structural detail.

Weston Electrical Instrument Company
13 Weston Avenue, Newark, N. J.

23 Branch Offices in the Larger Cities

Model 329 Polyphase Portable Wattmeter

This group also comprises Model 310 Single Phase and D. C. Wattmeter, Model 341 A. C. and D. C. Voltmeter and Model 370 A. C. and D. C. Ammeter.

Weston Models include complete groups for Portable and for Switchboard Service on A. C. and on D. C. circuits, together with many instruments designed for special purposes. Write for particulars regarding any need.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN
Published by the McGraw-Hill Publishing Company, Inc.

Vol. 70 NEW YORK, SATURDAY, AUGUST 18, 1917 No. 7

Issuing Securities in Advance of Expenditures

IN AUTHORIZING a seven-million-dollar security issue by the New England Power Company in a recent decision, the Gas and Electric Light Commission of Massachusetts took a constructive step of general interest from the standpoint of utility regulation. The company urged the commission to grant the issue before any considerable portion of the funds represented had been expended; in fact, less than 1 1/3 per cent of the proposed outlay for new plant facilities and system improvements imperatively needed could be shown to the board as paid out or borrowed under the usual note arrangement. The petitioner maintained that with the commission's advance approval the former would stand a much better chance of marketing its new securities, and in view of the present war conditions a majority of the board took this view.

New England is in danger of a serious coal shortage. Demands for power are increasing rapidly, and hydroelectric development is being actively pushed to help meet the situation. Although it is usual to require exhibits of expenditures constituting a pretty fair proportion of the security total before approving an issue, the board realized the importance of prompt and favorable action and performed a patriotic service in taking it. By holding back permission to issue about $1,000,000 of the total for a year, the commission safeguarded the whole issue with respect to the total cost of the work and put the company in a position to take full advantage of any reductions in the cost of labor or material should such occur within the next twelve months as the result of an improved international situation or other cause at present not in evidence.

The American Academy of Engineers

WE REPORTED in our news columns last week the passage of the Senate bill incorporating the long-projected American Academy of Engineers, now brought into activity by the exigencies of the times. We trust that the bill will as promptly pass the House and bring the Academy into being as a fully organized national body. There are many technical organizations in the country. A constantly increasing list of bodies of specialists in one line or another gather for professional co-operation, but there has been for a long time and is now especially, in the national crisis, need for gathering the supreme engineering talent of the country in a single working brotherhood. Engineering today represents a very broad range of activities, the coordination of which, with the government service specially in view, is a highly important matter. Many engineers are members of the several technical bodies with which their activities come most closely in touch, yet there is need, filled by the constitution of the present Academy, for bringing all branches of engineering together on a common meeting ground. The closeness of the contact between one group of engineers and another is constantly increasing, and it will become closer yet under the pressure of technical work brought on by the conditions of war. That the Academy as constituted can be of great and immediate service to the government goes quite without saying, and it is an especially appropriate thing that it should be incorporated now, at the present session of Congress, as part of the country's preparation for defense. Of course, the Naval Advisory Board and the Engineering Council are both doing excellent work in the present emergency, and there will be co-ordination of the activities of all such bodies. The first mentioned is, however, a more or less temporary body, while the American Academy of Engineers and the Engineering Council will be permanent organizations.

Control of the Coal Supply

ONE of the most important things in the food control bill from the standpoint of industry is the special authority delegated to the President for the administration of the coal resources of the country. Nothing touches more deeply the very roots of organized society than its supply of fuel. Many estimates have been made of the magnitude of the coal supply and the probable date of its exhaustion or depletion to an extent almost equivalent to exhaustion. These estimates have looked forward from one to several centuries, but the fact is that real fuel scarcity has been brought upon us prematurely by the conditions of war, a cause never contemplated by any prophet. The time is actually here when the fuel supply for all purposes, public and private, is temporarily reduced to a condition corresponding with a great and genuine scarcity of resources. Many an industry finds itself in hard straits for the coal necessary to operate its works or driven to purchase what scant supply can be obtained at almost impossible prices. Lack of adequate transportation, to say nothing of unmitigated profiteering, is at the bottom of the difficulty. The condition is not yet quite so bad as that which was brought upon England 250 years ago when the Dutch were sweeping the seas, but it arises from the same fundamental cause, the breaking down of communications under the stress of war.

The power now vested in the President gives him practical control of the situation. That he will use it

wisely and reasonably we believe, and that he will use it promptly and efficiently we earnestly pray. Before long the winter will be upon us, when difficulties of transportation are still further increased and quick measures of relief are doubly valuable. It is absolutely necessary that the manufacturers needful for the country's success, and the public servants necessary to hold the status quo of our civilization, should be assured of the fuel necessary to their needs; and it is no less important that the householder, who in the long run has to bear the brunt of financing the war, should not be doubly burdened by misfortune or extortion. We are not inclined to worry about the food supply, for its sources are widely distributed. Its amount bids fair to be adequate, and if the waste be stopped there should be no serious shortage. But the fuel supply is absolutely dependent upon organization of transportation and on the prevention of shortened production or hoarding at the hands of the profiteer. There is no feature of the bill just passed which deserves higher commendation than the conferring of full powers to deal with this vital fuel proposition.

Regulation with V-Connected Transformers

WHEN three-phase, 1100-volt distribution systems are tapped for the supply of alternating current to a consumer, it is customary to install but one transformer, when electric lighting only is demanded. This is an ordinary single-phase transformer, with its primary winding connected between one pair of the three distributing lines, so that only one phase of alternating current is supplied to the consumer's lamps. In order to prevent all the lighting load from falling on one and the same phase of the system, care is taken to distribute such single-phase transformers, with more or less uniformity, among the three phases of the system.

When, however, polyphase motors have to be supplied on the consumer's house mains, more than one phase must be tapped at the house service. In the case of a relatively large motor, it is desirable to tap all three phases. In Europe one step-down three-phase transformer is ordinarily used in such cases, with interlinked three-phase magnetic circuits and with three-phase primary and secondary windings. In America the custom is to employ three independent single-phase step-down transformers, one on each phase. Each of these methods of supply has its particular advantages and disadvantages. In the common case of but a small amount of polyphase power being required, only two single-phase transformers are installed, which, being connected in V, as it is called, provide three-phase voltages between the three secondary house mains. Assuming that no accident ever happens to either of the two V-connected transformers, this arrangement is entirely satisfactory at small loads. At or near rated load, the two V-connected transformers are not able to maintain their terminal voltages so well as a corresponding set of three delta-connected transformers. The voltage collapses on the side that has no transformer directly assigned to it. A pair of V-connected step-down transformers are therefore not so well able to maintain a symmetrical three-phase system of secondary voltages under load as a trio of delta-connected step-down transformers, and their plant efficiency under load is also inferior. Nevertheless, the plan works surprisingly well in a large number of cases.

The article by Leslie F. Curtis which we print this week reports the voltage regulation under different conditions of load and power factor for a particular pair of V-connected 10-kva., 1100-volt transformers. The results show that, at unity power factor and 150 per cent of rated load current, there may be very appreciable unbalancing, except in the case, of course, where all the load is carried on the two sides of the system which have the transformers.

Cost of Factory Lighting

IN THE current issue of the ELECTRICAL WORLD Professor Clewell rounds out his recent discussions of factory lighting by an analysis of costs as dependent on the various items which go into the annual charges, paying especial attention to the effect of the size of the units upon expense. Within limits, a few units form a cheaper equipment than do many, this being subject to the varying conditions imposed by the necessities of distribution and the grade of illumination required. In making or analyzing any estimates of this kind the construction costs will, of course, vary enormously, depending on the class of building, the uses to which it is put, the costs at the moment of material and labor and a good many other factors, so that one may say at the start that it is difficult to find two cases exactly comparable. The best that can be done is to analyze each case so thoroughly that one can accurately deduce its relation to other cases. A great deal of this cost reckoning is a matter of bookkeeping, as in the example cited by Professor Clewell where the cost per outlet was carried clear back to the transformer and switchboard equipment. Such an all-inclusive scheme may be at times justifiable, but is likely to involve considerable errors and certainly is not a ready basis for the comparison of lighting installations as to initial cost.

What is much more important is the figure for a complete installation of wiring, lamps and accessories up to the switchboard. In some cases further segregation in the costs compared is necessary, as when the new system is operated from old mains. One cannot in the long run do much more than furnish general data for which rough estimates of cost can be made, just as the complete solution of the illumination problem in any given factory cannot wholly be trusted to general average but must involve factors based on local circumstances. The main fact brought to the fore in Professor Clewell's admirable series of papers is the necessity of good lighting in factories as a means of securing proper efficiency of operation under working conditions. That the average factory is not well lighted and that its output can be increased in quantity and quality by suitable illumination are facts which stand out pre-eminently. Certain general methods of illumination and approximate figures

as to requirements may be taken by the help of Professor Clewell's various tables as generalized data, just as a contractor can block out the cost of an office building of any particular type per cubic foot without harassing his soul with details. In each case these details have to be considered before final figures are secured and the whole scheme placed in construction. At the present moment it takes the wisdom of the serpent to figure even the approximate costs of material and labor with any likelihood that these costs will hold true when the work is actually undertaken. But the broad lines of construction and of cost estimation here given are sound and will be found most helpful in dealing with the concrete cases which come before the engineer or the manager. While the war is on there will be a keener necessity for high-grade illumination than ever before, on account of the greatly increased amount of night work, and the information here presented will be found most pertinent.

Government Nitrate Plants

THE passage of the food control bill, giving incidental plenary powers to the President with respect to securing an adequate stock of nitrate of soda for agricultural purposes, finds the situation as to ways and means of accomplishing the necessary result in a somewhat chaotic state. Several projects for the fixation of nitrogen have been elaborated, involving both the utilization of water powers in the possession of the government and the building of steam plants, or the combination of both as in one example recently brought to notice in these columns. Unfortunately, prior to the outbreak of the war the synthetic nitrate industry was in a particularly indeterminate condition. What information was available was hidden in a few hands, and accurate data as to output and costs have been painfully lacking. Under the present bill the government would seem to have an absolutely free hand, with $10,000,000 available as a starter. With all the expert knowledge that can be summoned, decision on methods of plants is none too easy. That it will be made in accordance with the best judgment now available we must rest assured, whether time and experience back up that particular judgment or not. The need for nitrates may turn out to be less acute than has been feared, but the lesson driven home by the war is that it is the part of wisdom not to be dependent on outside sources for materials so vital to the country's prosperity.

We are not inclined to worry about the present situation, since immense crops are in prospect for the season at hand. After all is said and done, the food proposition is probably less serious than some calamity howlers would have us believe. We have been feeding ourselves, and for the most part our allies, for the last two years without any particular struggle, to say nothing of furnishing Germany with large amounts of food and other necessary materials through neutral sources. If this latter leak is stopped, there seems little likelihood that we shall fail this year or the next to meet all requirements. The number of mouths to be fed remains fairly constant, while the acreage under cultivation and the yield are certainly not diminishing, so that the real problem consists in a somewhat extensive redistribution of available material. An army of a million and a half or two million men in the field makes no really serious draft on the man power of the nation. A bigger number of men than this is idle, on vacation or otherwise unproductive a large part of the time. It is the possibility of a prolongation of the war, of four or five million men under arms, and a consequent extraordinary scarcity of labor, that constitutes the serious phase of the matter.

If we begin now, there is time enough to get the nitrate industry under way. We have the resources and the talent necessary for the work, and we believe the government will utilize these promptly enough to meet the requirements. Personally we earnestly hope that if the work is undertaken via the electrochemical route it will be done by the utilization of some of the available water powers. In the present necessity for transportation, carrying a finished product is a much more sensible proposition than carrying the raw material, including fuel, particularly when the transportation of necessary energy can be economically made over wires instead of rails. The main thing now is to get the industry actually into efficient being, and on a considerable scale, so as to meet the requirements of intensive working if the time shall come when a really serious shortage of men will have to be faced. At all events, let the work go on steadily to such a finish that the country can never again find itself short of important material through dependence on an interrupted foreign supply.

The Coming Issues

OPINIONS of various central station companies on what subjects should be taken into consideration in locating electric service offices will be presented in the next issue of the ELECTRICAL WORLD. Among the most important factors named is the ease with which consumers can reach an office to pay bills, purchase appliances, enter orders for service, etc. The industrial-lighting series by Prof. C. E. Clewell ends with the present issue. Another branch of the lighting field, street illumination, will be treated in a series beginning with the Sept. 1 issue by J. R. Cravath. The first installment will deal with the general principles involved in lighting streets and the effects desired. Lighting of an underground passageway and the experience of the St. Louis company in selling electric ranges are other articles which will be taken up in the next issue, in addition to the regular departments devoted to operating practice, commercial service and current news, including that of the trade. The "National Service Number," dated Sept. 1, will tell how the electrical industry is "doing its bit" in furnishing men, money and, what is of equal importance, the means of hastening the production of supplies—besides endeavoring in every way possible to increase output and keep down costs.

Initial and Operating Cost of Factory Lighting

Cost Values for Different Classes of Wiring—Discussion on Initial Costs of Larger and Smaller Lamps for Given Factory Areas, Supplemented by an Analysis of Annual Operating Charges

BY C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

SUMMARY.—In this article the author outlines the items included in the wiring for typical outlets in the factory system and discusses the elements of installation for various building constructions. Cost values for different classes of wiring are given so as to show the relative labor and material charges, and a large number of initial costs are included, based on actual installations and so arranged as to show the cost per outlet and the cost per unit of floor area. The latter furnish an interesting basis for comparing the initial costs of larger and smaller lamps for given factory areas. The discussion on initial costs is supplemented by an analysis of annual operating charges, first, in a general way applicable to all types of lamps, and, second, applied specifically to tungsten lamps of a given type and size. The unusual recent advances in the prices of wiring materials make it difficult, or even impossible, to estimate on new work at this time on a basis of actual costs of older installations, and while the use of the values in this article is subject to this limitation, they show how much the initial costs of lighting have amounted to under actual industrial conditions in the past, and hence furnish an interesting basis of comparison when estimates are prepared for new work to be installed under approximately the same conditions.

TO GIVE a unit cost per outlet for any given type and size of lamp is incomplete and may even be very misleading as a guide unless the physical surroundings governing the installation are known as well as the unit costs of the various items of material included and the wage rates of the wiremen who performed the work. To illustrate the point in question, a figure was given some time ago for the cost per outlet of 100-watt tungsten lamps as $22.28. An investigation of this case shows that this cost includes the lamp and wiring materials immediately incident to the installation, the labor charges for wiring, and also the portion of the transformer equipment, the high-voltage fuses, the switchboards and the lightning arresters chargeable to each outlet.

In this article a unit cost for installing a 100-watt tungsten lamp (same type and size as above) is given

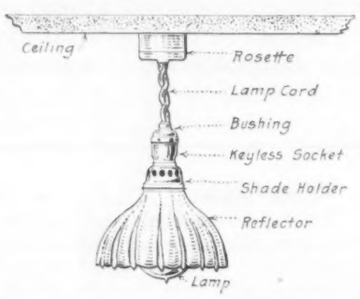
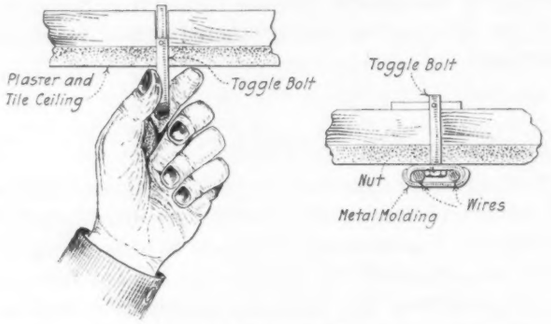


FIG. 1—TYPICAL OUTLET OF THE KIND REFERRED TO IN TABLES

as low as $2.44, approximately one-tenth the above figure, a fact which makes obvious the necessity for clearly specifying just what is included for each outlet in the following discussion on initial costs. It is well to note that while a complete unit cost for installing a given lamp under price conditions which may be, and are most likely to be, entirely different from those prevailing at this time is limited in its application to estimates for new work, the unit costs given in the accompanying tables possess several fundamental points of interest as outlined below.

Thus the figures given herewith, because they all apply to approximately the same conditions of material prices and wiring wage rates, may be used to compare



FIGS. 2 AND 3—INSERTING TOGGLE BOLT IN PLASTER AND TILE CEILING; METAL MOLDING AND WIRES IN PLACE ON A TILE AND PLASTER CEILING

the expense of wiring for the various classes of ceiling and mill constructions, and they show, moreover, how the initial cost per outlet and the initial costs per 1000 sq. ft. (92.9 sq. m.) of floor area vary with the different sizes of lamps for a given intensity of the illumination, the quantity of illumination being closely comparable in all of the installations listed. It is to realize these latter advantages, rather than to suggest their use for estimates, that these costs are given.

TABLE I—TYPICAL ITEMS INCLUDED PER OUTLET

Common to each outlet:
(1) Lamps of given type, size and voltage.
(2) Reflectors suitable for the size of lamp, and the spacing and mounting height.
(3) Shade holders of the type suitable for the reflectors.
(4) Keyless sockets.
(5) Fused ceiling rosettes.
(6) Socket bushings.

Proportioned per outlet:
(7) Snap switches (one switch usually controls several lamps).
(8) Fuse blocks, plugs and fuses.
(9) Lamp cord (required mainly between rosettes and sockets).
(10) Conduit and conduit boxes; or
(11) Wood (or metal) molding (sometimes both conduit and molding are used in a given installation).
(12) Screws, tape and solder.
(13) Wire for the circuits.
(14) Labor and overhead.

In Fig. 1 the typical outlet referred to in the tables is shown, consisting of the lamp and reflector, shade holder, socket, bushing, a short length of lamp cord, and ceiling rosette. To these items are added the wiring materials for the circuits between the lamps and the service mains and for the switch loops, also the

labor and overhead charges. All of the initial costs given refer to wiring work performed by the electrical department in a part of a large manufacturing plant, where the work of relighting the buildings involved a cost of about $100,000 for lamps and wiring only. Because of the large amount of this work, the electrical department became very proficient, and hence the labor item is probably considerably lower than the same work would be in a small plant. Furthermore, the materials were purchased in large quantities, this likewise tending to reduce the total costs below the values which would be found in many other cases.

TABLE II—ESTIMATED COSTS PER OUTLET FOR INSTALLING 60-WATT AND 100-WATT TUNGSTEN LAMPS

Lamp	Class of Wiring	Material	Labor
60-watt	Wood molding on wood ceiling	$1.40	$1.20
60-watt	Wood molding on stringer boards	1.78	1.41
60-watt	Metal molding on plaster ceiling	1.30	1.36
100-watt	Wood molding on wood ceiling	1.17	0.91
100-watt	Wood molding on stringer boards	2.05	1.36

TABLE III—ACTUAL COSTS FOR INSTALLING 60-WATT TUNGSTEN LAMPS ON WOOD CEILINGS WITH WOOD MOLDING*

Number of Installation	Nature of Space	Total Cost of Installation	Cost per Outlet	Cost per 1000 Sq. Ft. of Floor	Number of Lamps in Installation	Approximate Ceiling Height, in Ft.	Approximate Watts per Sq. Ft.	Approximate Floor Area, in Sq. Ft.	Average Spacing Between Lamps, Ft. In.
1	Factory office	$223.36	$3.11	$69.60	72	12	1.35	3205	6-8
2	Factory office	72.37	3.01	75.36	24	12	1.50	960	7-9
3	Factory office	163.03	3.39	116.00	48	13	2.05	1405	6-2
4	Factory office	100.51	4.78	139.88	21	13	1.75	719	6-4
5	Manufacturing	478.99	2.66	51.17	180	10	1.15	9360	8-0
6	Packing space	83.89	3.49	65.00	24	10	1.12	1290	7-6
7	Factory office	84.05	3.50	90.03	24	12	1.60	900	6-6
8	Factory office	47.31	3.94	143.50	12	12	2.18	330	5-6

Average cost per outlet, $3.48. Average cost per 1000 sq. ft., $93.82.
*A portion of the costs discussed in this article were made the basis for a brief report on the general subject of shop-lighting costs in the *American Machinist*, Vol. 46, No. 16, pp. 677-680.

total cost by the number of lamps in the system, and the cost per 1000 sq. ft. (92.9 sq. m.) of floor area being found by multiplying the total cost by 1000 and then dividing by the total floor area served by the system.

CLASSES OF WIRING LISTED

The plaster and tile ceilings are treated as shown by Figs. 2 and 3. The ceiling is drilled to receive a toggle bolt, to which the metal molding is attached as in Fig. 3. The general appearance of such a ceiling equipped with metal molding is shown in Fig. 4. The details of the use of wood molding on ordinary wood ceilings, a class of wiring referred to in some of the tables, are so familiar that they require no explanation.

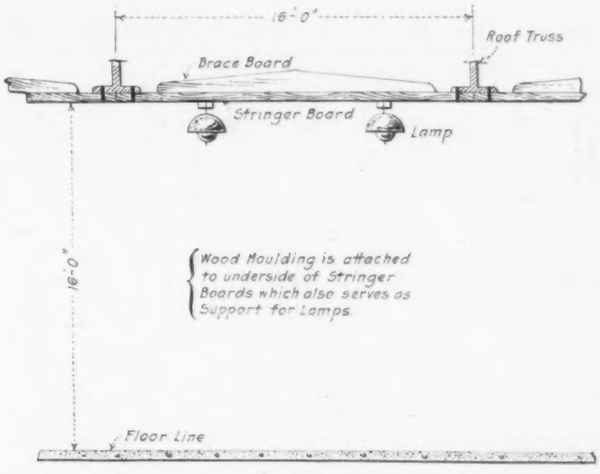


FIG. 5—METHOD OF SUPPORTING STRINGER BOARDS BETWEEN ADJACENT ROOF TRUSSES

For open-girder roof construction the use of moderate-sized lamps may bring many if not all of the lamps, for symmetry, at points between the trusses, and hence the use of stringer boards as shown in Fig. 5 has been found of advantage. These boards are braced for the rather long spans, and the wood molding and lamps are attached to the under sides of them. In Fig. 6 an idea is given of the appearance of these stringer boards in an actual installation. The brick arched ceiling referred to in one of the tables has the general outlines shown by Fig. 7. Here baseboards, attached to the iron trusses, serve as a support for molding and lamps. It will be noted from the tables that while the cost per

FIGS. 4 AND 6—PLASTER AND TILE CEILING SHOWING INSTALLATION OF METAL MOLDING; OPEN-GIRDER ROOF CONSTRUCTION WITH STRINGER BOARDS IN PLACE AS SUPPORT FOR WOOD MOLDING AND LAMPS

A typical list of items constituting an outlet like that in Fig. 1 would be made up somewhat as shown in Table I. The total cost of a given installation is the sum of the individual items, in general as listed in the table, the cost per outlet being found by dividing the

outlet is usually higher for the larger lamps, the cost per 1000 sq. ft. (92.9 sq. m.) of floor area is usually lower for the larger lamps. The difference, however, is not enough to warrant the use of large lamps for low ceilings, because of the many advantages of small lamps for such spaces from the illumination standpoint.

The initial cost tables refer, in general, to a list of material similar to the foregoing table of typical items included per outlet, and do not include generating or transforming equipment. To show the relative costs for material and labor per outlet, Table II has been prepared on a basis of estimated values of material and labor for various classes of wiring as listed. The material in this one case does not include the lamp or the reflector. In all of the remaining tables the lamp and reflector are included as a part of the cost per outlet.

In Tables III to VII actual costs to install various sizes of tungsten lamps under varying factory condi-

TABLE IV—ACTUAL COSTS FOR INSTALLING 60-WATT TUNGSTEN LAMPS ON TILE AND PLASTER CEILINGS WITH METAL MOLDING

Number of Installation	Nature of Space	Total Cost of Installation	Cost per Outlet	Cost per 1000 Sq. Ft. of Floor	Number of Lamps in Installation	Approximate Ceiling Height, in Ft.	Approximate Watts per Sq. Ft.	Approximate Floor Area, in Sq. Ft.	Average Spacing Between Lamps, Ft. In.
9	General office...	$121.16	$4.48	$114.30	27	12	1.54	1053	7-0
10	General office...	169.85	4.59	122.00	37	12	1.59	1397	6-6
11	General office...	114.23	3.08	97.02	37	10	1.90	1144	5-9
12	General office...	235.60	3.99	93.90	59	12	1.65	2509	7-0
13	General office...	122.25	3.82	105.84	32	13	1.66	1155	6-8
14	Filing vault....	196.70	3.71	66.30	53	10	1.07	2966	8-7
15	General office...	31.96	3.99	96.85	8	10	1.45	330	7-0

Average cost per outlet, $3.95. Average cost per 1000 sq. ft., $99.46.

TABLE V—ACTUAL COSTS FOR INSTALLING THE LARGER TUNGSTEN LAMPS ON WOOD CEILINGS WITH WOOD MOLDING

Size of Units	Number of Installation	Nature of Space	Total Cost of Installation	Cost per Outlet	Cost per 1000 Sq. Ft. of Floor	Number of Lamps in Installation	Approximate Ceiling Height, in Ft.	Approximate Watts per Sq. Ft.	Approximate Floor Area, in Sq. Ft.	Average Spacing Between Lamps, Ft. In.
100-watt	16	Manufacturing..	$564.65	$2.44	$41.41	243	13	1.78	13,633	8-0
	17	Machine shop..	204.88	4.65	53.86	60	12	1.56	3,840	9-0
250-watt	18	Manufacturing.	46.45	7.74	42.50	6	16	1.38	1,092	13-6
	19	Shop space....	102.63	5.13	34.21	20	20	1.67	3,000	10-6
	20	Shop space....	185.52	7.73	64.40	24	20	2.08	2,880	9-0
500-watt	21	Shop space.....	160.08	13.34	67.50	12	20	2.08	2,375	14-0

Average costs per outlet: 100-watt units, $3.54; 250-watt units, $6.87. Average costs per 1000 sq. ft.: 100-watt units, $47.64; 250-watt units, $47.04.

TABLE VI—ACTUAL COSTS FOR INSTALLING TUNGSTEN LAMPS ON STRINGER BOARDS ATTACHED TO OPEN ROOF TRUSSES, WIRING PLACED IN WOOD MOLDING

Size of Units	Number of Installation	Nature of Space	Total Cost of Installation	Cost per Outlet	Cost per 1000 Sq. Ft. of Floor	Number of Lamps in Installation	Approximate Ceiling Height, in Ft.	Approximate Watts per Sq. Ft.	Approximate Floor Area, in Sq. Ft.	Average Spacing Between Lamps, Ft. In.
100-watt	22	Manufacturing.	$182.46	$5.35	$82.03	34	16	1.63	2090	8-5
	23	Manufacturing.	724.64	4.83	77.39	150	9	1.60	9360	8-0
250-watt	24	Shop space....	76.79	7.68	47.80	10	18	1.56	1603	12-8
	25	Manufacturing.	189.81	10.54	62.76	18	16	1.48	3024	13-0
	26	Paint shop....	116.55	7.77	44.40	15	16	1.77	2121	13-9
	27	Shop space....	146.34	5.46	22.90	29	16	1.13	6400	14-6

Average costs per outlet: 100-watt units, $5.09; 250-watt units, $7.86. Average costs per 1000 sq. ft.: 100-watt units, $82.35; 250-watt units, $44.47.

TABLE VII—ACTUAL COSTS FOR INSTALLING TUNGSTEN LAMPS ON ARCHED BRICK-CEILING CONSTRUCTION HAVING IRON TRUSSES ON WHICH BASEBOARDS AND MOLDING WERE MOUNTED

Size of Unit	Number of Installation	Nature of Space	Total Cost of Installation	Cost per Outlet	Cost per 1000 Sq. Ft. of Floor	Number of Lamps in Installation	Approximate Ceiling Height, in Ft.	Approximate Watts per Sq. Ft.	Approximate Floor Area, in Sq. Ft.	Average Spacing Between Lamps, Ft. In.
100-watt	28	Tool room.....	$15.13	$2.16	$31.06	7	9	1.44	487	8-5
250-watt	29	Dynamo room..	407.22	10.18	78.58	40	20	1.93	5,183	14-0

Note.—It should be observed carefully that the watts-per-square-foot values as listed in each of these tables relate to installations where the older vacuum type of tungsten lamps was in use.

TABLE VIII—TYPICAL ITEMS INCLUDED UNDER ANNUAL OPERATING COSTS

(1) *Annual fixed charges:*
An interest charge on the total initial investment.
A depreciation charge on the non-renewal part of the equipment, that is, on everything included under the initial cost, except the lamp (or the tube for mercury-vapor lamps, or the carbons for arc lamps).
A charge for cleaning at regular intervals independently of the number of hours the lamps are used. If cleaning is done at the time of trimming for arc lamps, as an example, it may then be added as a part of the maintenance, since it then becomes a function of the number of hours the lamps are burned.

(2) *Maintenance charges:*
Repairs on equipment, that is on the units themselves where arc lamps and mercury-vapor lamps are used, also on sockets, switches, etc.
Renewals of tungsten lamps, or tubes of mercury-vapor lamps, or carbons for arc lamps.
Labor for the above items.

(3) *Energy charges:*
This charge must be based on the rate per kilowatt-hour applicable, and depends on the number of hours the lamps are used per annum.

TABLE IX—ANNUAL OPERATING COST (1000 HOURS' SERVICE) OF A 300-WATT MAZDA "C" LAMP†

Cost of lamp, list price	$3.000
Cost of lamp, standard package, discount	2.700
Cost of reflector standard package, discount	3.371
Cost of unit standard package, discount	6.071
Annual fixed charges:	
Interest on investment at 6 per cent	$0.364
Depreciation on reflector, 12½ per cent	0.421
Labor for monthly cleaning	0.360
Total	$1.145
Maintenance cost per 1000 hours of service:	
Lamp renewal at standard-package prices	$2.700
Lamp renewal at $150 contract prices	2.490
Lamp renewal at $1,200 contract prices	2.190
Energy cost per 1000 hours of service:	
At 1 per cent per kilowatt-hour	$3.000

†In this case interest and depreciation are based on cost of lamp and reflector only, that is to say, no wiring expenses are included.

tions are given. The conditions governing the installation are indicated at the top of each table, and the meaning of each column of figures is explained by the

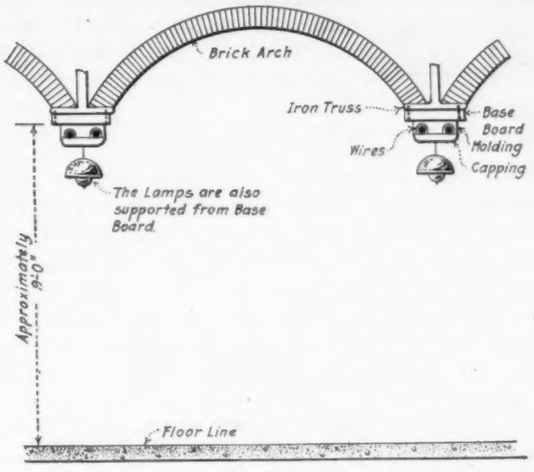


FIG. 7—METHOD OF SUPPORTING WOOD MOLDING AND LAMPS ON THE IRONWORK OF A BRICK CEILING

heading at the top of the column. It is particularly interesting to note that in some of the very large installations, indicated by the number of lamps, the costs per 1000 sq. ft. (92.9 sq. m.) are lower than for the smaller systems. Averages will be found at the end of each table.

TABLE X—TOTAL ANNUAL OPERATING COSTS FOR A 300-WATT MAZDA "C" LAMP FOR VARIOUS LAMP PRICES, ANNUAL HOURS OF SERVICE AND RATES

	Energy Rate per Kw.-hr.	Total Annual Operating Cost
1000 hours' operation per year and lamps purchased on $150 contract	1	$6.64
	2	9.64
	3	12.64
	4	15.64
	5	18.64
	6	21.64
	8	27.64
	10	33.64
1000 hours' operation per year and lamps purchased on $1,200 contract	1	6.34
	2	9.34
	3	12.34
	4	15.34
	5	18.34
	6	21.34
	8	27.34
	10	33.34
4000 hours' operation per year and lamps purchased on $150 contract	1.0	23.11
	1.5	29.11
	2.0	35.11
	3.0	47.11
	4.0	59.11
4000 hours' operation per year and lamps purchased on $1,200 contract	1.0	21.91
	1.5	27.91
	2.0	33.91
	3.0	45.91
	4.0	57.91

OPERATING COSTS

The annual costs of operating a lighting system may conveniently be divided under three heads, as indicated in Table VIII.

To illustrate the items in Table VIII on the basis of a given type of lamp, the individual charges there outlined are given for a 300-watt Mazda "C" lamp in Table IX.[1] The total annual operating charge is then found by adding together the items under the three heads in this table, care being taken to select the item corresponding to the proper discount for lamps and to apply the proper energy charge. Obviously if the number of hours of service per annum differs from the value used in the table, a corresponding change will be made in the maintenance and energy items.

The total annual operating costs for a 300-watt Mazda "C" lamp for various energy and discount rates are given in Table X.

COMMUTATION DEVICE FOR DIRECT-CURRENT MACHINES

Separate Commutating Generator Is Placed Outside the Main Bearing, Avoiding the Use of Sliding Contacts

In order to avoid the use of magnetic distortion due to interpole, B. Ljunstrom and A. D. Widstrom of Stockholm, Sweden, in patent No. 1,228,936, suggest the use of a separate commutating generator placed outside the main bearing and formed with a rotating armature and a stationary field structure. The supply leads for the primary winding of the commutation transformer are drawn through a hole bored in the shaft. The stationary field coils are traversed by the main current from the direct-current generator. In this way by means of a transformer a proper commutating emf. is obtained that avoids the use of sliding contacts of any kind for the connections between the commutation generator and the commutation transformer.

CRACKING HYDROCARBON VAPORS BY ELECTRICITY

Vapors Passed Through an Electric Brush Discharge Field, Increasing the Amount of Non-Condensible Gases

A process that aims to obtain by means of an electric discharge a greater yield of fixed gases from hydrocarbon vapors is the development of J. G. Davidson and R. W. Ford of Vancouver, B. C., Canada. Patent No. 1,229,042 has been granted covering the discovery that by passing such vapors through an electric brush discharge field the amount of non-condensible gases is increased. In actual tests it is claimed that by this process the amount of CH_4 in the gas has been increased from about 25 per cent to approximately 40 per cent, while the amounts of C_nH_{2n} were increased from between 7 per cent and 10 per cent to between 20 per cent and 23 per cent. Ordinarily the gas is conducted through a plurality of conduits formed as vertical pipes connected at their lower ends to a supply header and at their upper ends to an outlet header, the discharge electrode being formed as wires hung axially in the pipes from an insulated support. The pipes are grounded and the electrodes are connected by a wire to a mechanical rectifier of the usual rotary type included in the high-tension circuit of a step-up transformer, the rectifier connected to ground.

[1]The data in this and in Table X are compiled from a supplement to Bulletin 20, on "Industrial Lighting," issued by the National Lamp Works of the General Electric Company, Sept. 20, 1915.

Engineering Training and Experience

An Analysis of the Qualifications of Forty-two Candidates for Electrical Engineering Position Paying $4,000 a Year—Their Age, Schooling and Present Salary

BY RICH. D. WHITNEY
Associate Professor of Electrical Engineering, Syracuse University

FOR an electrical engineering position the salary of which is $4,000 a year more than forty men filled out application papers showing their qualifications. The author was called upon to grade the papers, and in the course of the grading and analysis the facts enumerated below were brought out.

The candidates were from all parts of the United States, as the examination was not restricted to men from the State in which the position is open. Forty-two papers were fully answered, and from these this discussion is taken. The weight attached to the different questions may be divided into three parts—first, information; second, training, and third, experience.

Under information, the candidate was asked to give certain facts about himself, such as age, weight, height, etc. If any of these data were omitted, the examiner felt that the one taking the examination should be penalized. This section bore a weight of eleven points.

Under training, the extent of schooling was asked for both in regular schools and colleges and in correspondence courses. Besides which due credit was given to any research work which the candidate had done, any additional studies he had taken up, or any engineering or scientific societies of which he was a member. This section bore a weight of forty points.

Under experience, the candidate was asked to give his past history in the profession and any other qualifications which would tend to fit him for the position sought. This section bore a weight of forty-nine points.

A summary of the results which were obtained from this group of papers is shown graphically in Fig. 1. The abscissas are the numbers of the candidates from one to forty-two inclusive. Curve I shows the ages of the several candidates. Curve II shows the education which the men had received in regular schools and colleges. By adding to the ordinates of curve II the weight given to correspondence school work curve III was formed. A man who had been graduated from high school was rated at five points and the maximum rating of ten was given to a graduate of a technical college. Any academic education in excess of this did not obtain additional credit. Correspondence courses taken were given a maximum credit of four points, the greatest weight going to those who completed their courses and received a diploma.

The relative experience of the candidates is shown in curve IV. Curve V gives the total grade given each man. Curve VI shows the present salaries of the candidates in dollars per month.

Fig. 2 is a "shotgun" diagram which shows a number of points, the abscissas of which are education rating (curve II), and the ordinates salary (curve VI). Fig. 3 is a similar diagram having the same ordinates but ages (curve I) for abscissas. Fig. 4 is another diagram of the same type, having ages for abscissas and education for ordinates.

Some very interesting conclusions may be drawn from the data here shown and attention will be called to some of them. It will be noticed that in most cases a peak in the age curve is accompanied by a depression in the education curve. The salary curve does not seem to bear any definite relation to the age and education curves, but is remarkably similar to the experience curve. The experience curve, however, is more or less dependent on the age and education ratings. It is also interesting to note how symmetrical the salary curve is with respect to the one-hundred-and-fifty-dollar-per-month line.

We learn from these several diagrams that the applicants were divided as follows:

Men having had less than a high-school education..... 8
Men who were high-school graduates.....10
Men having some college training but non-graduates.....11
Men who were technical college graduates.....13

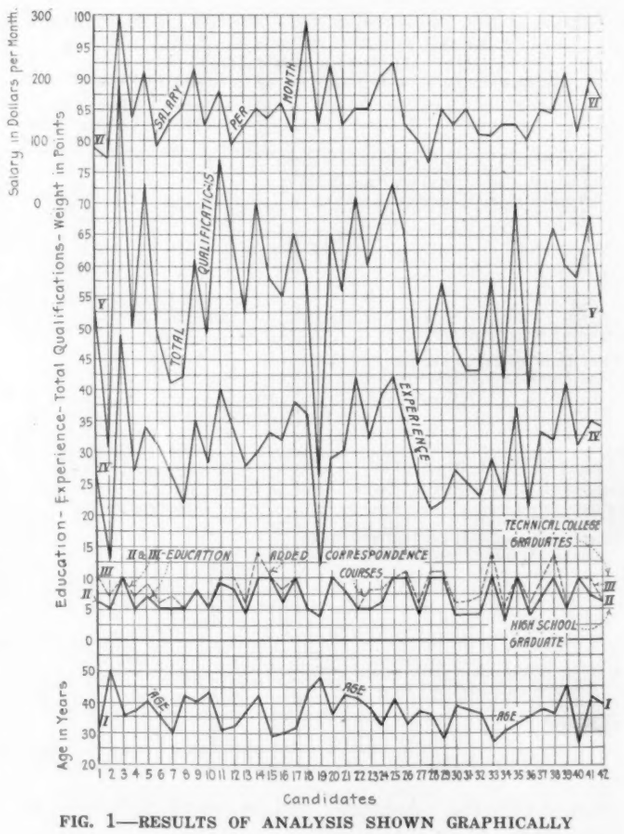
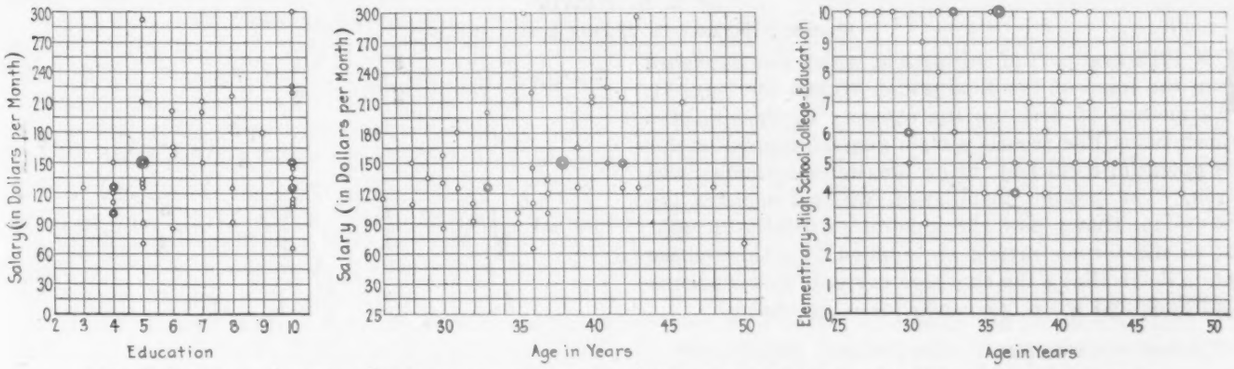


FIG. 1—RESULTS OF ANALYSIS SHOWN GRAPHICALLY

Of this number twenty-six had taken some correspondence course or courses in addition to the above resident schooling, but only four had received a diploma in such a course of any length. Only nineteen candidates were members of scientific or engineering societies, and only eleven had ever contributed anything to the technical press.

The average salary per month of the eight men who had not received a high-school diploma was $119.38 and the average age 37.6 years; the average salary of the ten high-school graduates was $150.80 and the average age 40.5 years; the average salary of the eleven college men who did not graduate was $164.36 and the average age 38 years; the average salary of the thirteen college graduates was $152 and the average age 33.3 years.



FIGS. 2, 3 AND 4—"SHOTGUN" DIAGRAMS SHOWING RELATIONS BETWEEN AGE, EDUCATION AND EARNING POWER

Only twenty men professed knowledge of any foreign language. Thirty-three had never been discharged from a position, and of the remaining nine six had been retired from positions for reasons not to their discredit. Four of the applicants had seen some form of military service for the United States of America.

It is interesting to note that of the fifteen men receiving a total grade of 65 or above on the whole test one was a high-school graduate, four had some college training and the remaining ten were graduates of technical colleges.

HANDLING RECTIFIER TUBES

Tube Life and Factors Affecting It—Value of Washing Tubes—Limits to Operating Temperature

Extended testimony bearing upon the life and handling of rectifier tubes was recently given in the Boston Edison street-lighting case by L. L. Elden, electrical superintendent of the company. Prof. H. E. Clifford of Harvard University, expert witness for the city of Boston, had previously stated that the average life of rectifier tubes was 2500 to 3000 hours. Mr. Elden said that these figures are correct for 4-amp. tubes, but that the life of 6.6-amp. tubes is far less on the average, the manufacturers refusing to guarantee them a life of more than 400 hours. If a tube fails inside of 400 hours, based on a six months' average of all the tubes in service, new tubes will be supplied. This is not considered a satisfactory form of contract, as one long-lived tube in the lot will raise the average above 400 hours, so that the operating company cannot collect for any tube of short life if it happens to come in that settlement period. A few tubes have run from 8000 to 10,000 hours' life.

The rectifiers are operated for a time and are then rested, upon advice of the manufacturers. The rest period may run from a week to three months. The vacuum is retained in better condition and for a longer period by this course. In this way a tube may disappear from service for some months, with no record of its use appearing on the intervening daily log sheets. After the tubes are removed from the tanks and washed they are not always restored to the same tank. All tubes are numbered. Each tank has four tubes, only two of which are used at a time. From the log entries the hours of service of each tube are deduced, no matter how irregular may be their use. In order to keep down the number of tubes used in figuring the average life, the witness advised making contracts for the tubes required by individual rectifiers, thereby limiting the guarantee to four tubes.

About two years ago a process consisting of a hot washing treatment was devised for restoring the vacuum in used tubes. Since that time the Boston Edison company has installed a washing plant to which idle tubes are taken from time to time from various plants or substations, washed and redistributed without regard to the source from which the tubes are drawn. Up to 1913, which marked the end of about two and a half years' record-keeping experience with lava-tipped tubes, the Boston company found that their life averaged about 2089 hours, but by Dec. 1, 1914, the life had dropped to 1334 hours, or 1274 hours for all tubes in use.

Since the war began manufacturers have had great difficulty in procuring the proper type of glass, the importation of some ingredients used in the tubes having entirely ceased. No more lava-tipped tubes can be obtained by the company, which is obliged to depend upon punched-iron tubes. The new washing process has enabled the company to bring back into service tubes which were formerly considered dead from the standpoint of serviceability. The lighter the load on the rectifier, the longer the life of the tube. When the tube is loaded up to the full rating of the rectifier, a little more than 6000 volts, the tube life becomes appreciably shorter. The operation of the tubes at 50 to 80 deg. Fahr. is urged by the manufacturers. If the tubes get cold they will not operate at all, and if they become overheated the leakage through the glass quickly destroys the vacuum. The temperature of the oil tanks is carefully watched and city water is circulated to keep it within the normal limits.

About three years ago the Boston Edison company nearly reached the point of abandoning rectifiers, and the result of a period of expert supervision led to the adoption of the four-tube sets in order to keep the equipment operating satisfactorily. About $100,000 worth of rectifiers are used in Boston proper and $128,000 worth on the entire system.

Transmission-Line Charging Currents—II

Method of Determining Charging Currents in a Three-Phase Line with One Conductor Grounded—Transposed and Non-Transposed Systems Considered

BY R. H. MARVIN

Electrical Engineer R. Thomas & Sons Company

IN THE first part of this article, which was published in the issue of the ELECTRICAL WORLD for Aug. 11, a method of deriving the capacity coefficients of a transmission line from a simple general expression for the potential coefficient, using Maxwell's formulas, was given. The present installment, which completes the discussion, shows how the general principles brought out in the former article are applied to a three-phase line in determining the charging currents under normal conditions and when one conductor is grounded.

CHARGING CURRENTS UNDER NORMAL CONDITIONS

The usual formulas for the capacity of a three-phase line, although they neglect the effect of the earth, are sufficiently accurate for determining the charging current of a transmission line under normal conditions in most instances. It is, however, of interest to determine the charging currents in terms of the capacity coefficients, as this affords a check on the approximate formulas. Two cases will be considered:

I. Neutral grounded. All voltages to ground equal.

II. Neutral either grounded or isolated, but all conductors transposed a complete number of turns, so that all voltages to ground may be assumed equal.

A third case exists where the neutral is isolated and the phases are not transposed. As the exact solution is quite complicated it is omitted.

Let v_1, v_2, v_3 be the instantaneous potentials of the three phases to ground in volts; v the maximum potential from line to ground in volts; V the effective potential from line to ground in volts; q_1, q_2 and q_3 the instantaneous charges on the line in coulombs; i_1, i_2 and i_3 the instantaneous charging currents in amperes; I_1, I_2 and I_3 the effective charging currents in amperes; α_1, α_2 and α_3 the angles of lead of the three currents; n is the frequency in cycles per second; $\omega = 2\pi n$, and l is length of the line. The latter will be in miles if the capacity coefficients are in farads per mile.

Case I.

$$v_1 = v \sin \theta$$

$$v_2 = v \sin (\theta + 120°) = v \left\{ -\frac{1}{2} \sin \theta + \frac{\sqrt{3}}{2} \cos \theta \right\}$$

$$v_3 = v \sin (\theta + 240°) = v \left\{ -\frac{1}{2} \sin \theta - \frac{\sqrt{3}}{2} \cos \theta \right\}$$

$$q_1 = l \left\{ C_{1\text{-}1} v_1 + C_{1\text{-}2} v_2 + C_{1\text{-}3} v_3 \right\}$$

$$= lv \left\{ (C_{1\text{-}1} - \frac{1}{2} C_{1\text{-}2} - \frac{1}{2} C_{1\text{-}3}) \sin \theta + \frac{\sqrt{3}}{2} (C_{1\text{-}2} - C_{1\text{-}3}) \cos \theta \right\}$$

$$i_1 = \frac{dq_1}{dt} = \omega \frac{dq_1}{d\theta} \quad \text{for } \theta = \omega t$$

$$i_1 = \omega lv \left\{ (C_{1\text{-}1} - \frac{1}{2} C_{1\text{-}2} - \frac{1}{2} C_{1\text{-}3}) \cos \theta - \frac{\sqrt{3}}{2} (C_{1\text{-}2} - C_{1\text{-}3}) \sin \theta \right\}$$

$$I_1 = \omega lV \sqrt{(C_{1\text{-}1} - \frac{1}{2} C_{1\text{-}2} - \frac{1}{2} C_{1\text{-}3})^2 + \frac{3}{4} (C_{1\text{-}2} - C_{1\text{-}3})^2}$$

$$\alpha_1 = \tan^{-1} \frac{C_{1\text{-}1} - \frac{1}{2} C_{1\text{-}2} - \frac{1}{2} C_{1\text{-}3}}{-\frac{\sqrt{3}}{2} (C_{1\text{-}2} - C_{1\text{-}3})}.$$

In a like manner:

$$I_2 = \omega lV \sqrt{(C_{1\text{-}2} - \frac{1}{2} C_{2\text{-}2} - \frac{1}{2} C_{2\text{-}3})^2 + \frac{3}{4} (C_{2\text{-}2} - C_{2\text{-}3})^2}$$

$$\alpha_2 = \tan^{-1} \frac{C_{1\text{-}2} - \frac{1}{2} C_{2\text{-}2} - \frac{1}{2} C_{2\text{-}3}}{-\frac{\sqrt{3}}{2} (C_{2\text{-}2} - C_{2\text{-}3})} - 120°$$

$$I_3 = \omega lV \sqrt{(C_{1\text{-}3} - \frac{1}{2} C_{2\text{-}3} - \frac{1}{2} C_{3\text{-}3})^2 + \frac{3}{4} (C_{2\text{-}3} - C_{3\text{-}3})^2}$$

$$\alpha_3 = \tan^{-1} \frac{C_{1\text{-}3} - \frac{1}{2} C_{2\text{-}3} - \frac{1}{2} C_{3\text{-}3}}{-\frac{\sqrt{3}}{2} (C_{2\text{-}3} - C_{3\text{-}3})} - 240°.$$

Case II. In this case each phase occupies the position of each conductor for one-third the length of the line. The sine component of the current for one phase in each of the three positions may be determined. Adding these three values gives the total sine component, which is zero. The sum of the three cosine components is likewise determined, and from this the effective current, giving:

$$I_1 = I_2 = I_3 = \frac{1}{3} \omega lV (C_{1\text{-}1} + C_{2\text{-}2} + C_{3\text{-}3} - C_{1\text{-}2} - C_{1\text{-}3} - C_{2\text{-}3})$$

$$\alpha_1 = \alpha_2 = \alpha_3 = 90°.$$

In applying the principles outlined in the first section of this article to a three-phase line with one phase grounded, a circuit with an overhead ground wire will be considered. If there is no ground wire, the terms involving its effect simply drop out. Two cases will be considered.

I. Conductors not transposed.

II. Line conductors transposed a complete number of turns.

The line conductors will be called Nos. 1, 2 and 3, No. 3 being grounded. The ground wire will be called No. 4. If it is desired to ground any other line conduc-

tor, the formulas are readily changed by simply changing the subscripts of the capacity coefficients in cyclical order. Thus, if the formulas are desired with conductor No. 1 grounded, change 3 to 1, 1 to 2, 2 to 3, in all the subscripts. Thus, $C_{3\text{-}3}$ would become $C_{1\text{-}1}$, $C_{2\text{-}3}$ would become $C_{2\text{-}1}$ or $C_{1\text{-}2}$, $C_{2\text{-}4}$ would become $C_{2\text{-}4}$, etc. The reverse change, that is 3 to 2, 2 to 1, 1 to 3, would give the equations with conductor No. 2 grounded.

It will be assumed that phase No. 1 is connected to conductor No. 1, phase No. 2 to conductor No. 2, and phase No. 3 to conductor No. 3. The current in the grounded phase, No. 3, is divided between the grounded line conductor, the ground wire and the earth. Let e_1, e_2 be the instantaneous potentials to ground of the ungrounded conductors in volts; e, the maximum potential from the ungrounded conductors to ground in volts; E, the effective voltage from line to line and from line to ground; q_1, q_2, q_3, q_4, and q_g the instantaneous charges on the conductors and earth in coulombs; i_1, i_2, i_3, i_4 and i_g the instantaneous charging currents in the conductors and earth in amperes; I_1, I_2, I_3, I_4 and I_g, the corresponding effective charging currents; α_1, α_2, α_4 and α_g, the phase angles between I_1, I_2, I_4 and I_g, respectively, and E_1, the effective voltage from phase No. 1 to ground, and α_2 the phase angle between I_2 and E_2, the effective voltage from phase No. 2 to ground. The remaining symbols are the same as in the last section.

Case I.

$$e_1 = e \sin \theta$$

$$e_2 = e \sin (\theta - 60°) = e \left(\frac{1}{2} \sin \theta - \frac{\sqrt{3}}{2} \cos \theta \right).$$

The reason that e_2 is displaced 60 deg. behind e_1 is as follows: If the voltage from No. 1 to No. 3 is $e \sin \theta$, then the voltage from 3 to 2 is $e \sin (\theta + 120°)$. Therefore the voltage from 2 to 3, or the potential to ground, is $e \sin (\theta + 120° - 180°) = e \sin (\theta - 60°)$.

$$q_1 = l \left\{ C_{1\text{-}1} e_1 + C_{1\text{-}2} e_2 \right\}$$

$$= le \left\{ (C_{1\text{-}1} + \frac{1}{2} C_{1\text{-}2}) \sin \theta - \frac{\sqrt{3}}{2} C_{1\text{-}2} \cos \theta \right\}$$

$$i_1 = \frac{dq_1}{dt} = \omega \frac{dq_1}{d\theta}$$

$$i_1 = \omega le \left\{ (C_{1\text{-}1} + \frac{1}{2} C_{1\text{-}2}) \cos \theta + \frac{\sqrt{3}}{2} C_{1\text{-}2} \sin \theta \right\}$$

$$I_1 = \omega lE \sqrt{C_{1\text{-}1}^2 + C_{1\text{-}1} C_{1\text{-}2} + C_{1\text{-}2}^2}$$

$$\alpha_1 = \tan^{-1} \frac{C_{1\text{-}1} + \frac{1}{2} C_{1\text{-}2}}{\frac{\sqrt{3}}{2} C_{1\text{-}2}}.$$

In a like manner:

$$I_2 = \omega lE \sqrt{C_{1\text{-}2}^2 + C_{1\text{-}2} C_{2\text{-}2} + C_{2\text{-}2}^2}$$

$$\alpha_2 = \tan^{-1} \frac{C_{1\text{-}2} + \frac{1}{2} C_{2\text{-}2}}{\frac{\sqrt{3}}{2} C_{2\text{-}2}} + 60°$$

$$I_3 = \omega lE \sqrt{C_{1\text{-}3}^2 + C_{1\text{-}3} C_{2\text{-}3} + C_{2\text{-}3}^2}$$

$$\alpha_3 = \tan^{-1} \frac{C_{1\text{-}3} + \frac{1}{2} C_{2\text{-}3}}{\frac{\sqrt{3}}{2} C_{2\text{-}3}}$$

$$I_4 = \omega lE \sqrt{C_{1\text{-}4}^2 + C_{1\text{-}4} C_{2\text{-}4} + C_{2\text{-}4}^2}$$

$$\alpha_4 = \tan^{-1} \frac{C_{1\text{-}4} + \frac{1}{2} C_{2\text{-}4}}{\frac{\sqrt{3}}{2} C_{2\text{-}4}}$$

$$I_g = \omega lE \sqrt{C_{1\text{-}g}^2 + C_{1\text{-}g} C_{2\text{-}g} + C_{2\text{-}g}^2}$$

$$\alpha_g = \tan^{-1} \frac{C_{1\text{-}g} + \frac{1}{2} C_{2\text{-}g}}{\frac{\sqrt{3}}{2} C_{2\text{-}g}}.$$

The quadrant in which the angles α_3, α_4 and α_g lie can be easily determined from the condition that I_3, I_4 and I_g must be so located that their resultant with I_1 and I_2 is zero. The total current in phase No. 3 is the vector sum of I_3, I_4 and I_g. The total current in the connection to the ground is the vector sum of I_4 and I_g.

Case II. The transposition of the line conductors causes each phase to occupy the position of each line conductor for one-third the length of the line. The formulas are derived by taking the sine and cosine components of the current for one-third the length of the line with the three phases in each of the three positions, adding these to give the total components for each phase, and combining the components to give the total current. The following simple formulas result:

Let

$$S_1 = (C_{1\text{-}1} + C_{2\text{-}2} + C_{3\text{-}3})$$
$$S_2 = (C_{1\text{-}2} + C_{1\text{-}3} + C_{2\text{-}3})$$
$$S_4 = (C_{1\text{-}4} + C_{2\text{-}4} + C_{3\text{-}4})$$
$$S_g = (C_{1\text{-}g} + C_{2\text{-}g} + C_{3\text{-}g}).$$

Then:

$$I_1 = I_2 = \frac{1}{3} \omega lE \sqrt{S_1^2 + S_1 S_2 + S_2^2}$$

$$I_3 = \frac{1}{\sqrt{3}} \omega lE S_2$$

$$I_4 = \frac{1}{\sqrt{3}} \omega lE S_4$$

$$I_g = \frac{1}{\sqrt{3}} \omega lE S_g$$

$$\alpha_1 = \tan^{-1} \frac{S_1 + \frac{1}{2} S_2}{\frac{\sqrt{3}}{2} S_2}$$

$$\alpha_2 = \tan^{-1} \frac{S_2 + \frac{1}{2} S_1}{\frac{\sqrt{3}}{2} S_1} + 60°$$

$$\alpha_3 = \alpha_4 = \alpha_g = -120°.$$

An examination of the expressions for α_1 and α_2 shows that α_1 is greater than 90 deg. by the same amount that α_2 is less than 90 deg., this being due to the charging current between phases Nos. 1 and 2.

Several examples from existing transmission lines will now be worked out.

Transmission Line A.—This line is a 33,000-volt, 40-cycle, three-phase, non-grounded system. The conductors are No. 0 B. & S. solid copper. The wires are transposed every 3 miles (4.8 km.) and are carried on pin-type insulators on wooden poles. There is no ground wire. The length of the line is 32 miles (51.5

TABLE I—DATA ON TRANSMISSION LINE IN FIG. 3

E	= 33,000 volts
V	= 19,050 volts
n	= 40 cycles
ω	= 251.3
l	= 32 miles
$a_1 = a_2 = a_3$	= .162 in.
(1, 2) = (2, 3)	= 86 in.
(1, 3)	= 51 in.
(1, 1′) = (2, 2′)	= 552 in.
(3, 3′)	= 480 in.
(1, 2′)	= 553 in.
(1, 3′)	= 481 in.
(2, 3′)	= 516 in.

km.). Fig. 3 shows the arrangement of the wires and the spacing between the wires and their images. The necessary data are given in Table I.

For all the following calculations five-place logarithms have been used and the results carried to four figures. Substituting these values in the formulas for the potential coefficients, the following values are obtained:

$P_{1,1} = 3.5324$ $P_{2,2} = P_{1,1}$ $P_{3,3} = 3.4717$
$P_{1,2} = 1.1864$ $P_{1,3} = .9745$ $P_{2,3} = 1.1563$

The preceding values are next substituted in the formulas for the capacity coefficients of three wires, giving in farads per mile:

$C_{1,1} = 1.285 \cdot 10^{-8}$ $C_{1,2} = -.3518 \cdot 10^{-8}$ $C_{1,g} = -.6898 \cdot 10^{-8}$
$C_{2,2} = 1.330 \cdot 10^{-8}$ $C_{1,3} = -.2434 \cdot 10^{-8}$ $C_{2,g} = -.6339 \cdot 10^{-8}$
$C_{3,3} = 1.302 \cdot 10^{-8}$ $C_{2,3} = -.3443 \cdot 10^{-8}$ $C_{3,g} = -.7143 \cdot 10^{-8}$

As the conductors are transposed, the formulas of Case II will be used for the charging current in both the normal condition and with phase No. 3 grounded, giving:

	Charging Current—Amperes	Charging Current—Per Cent of Normal
Normal current	2.480	100
Phase No. 3 grounded		
I_1	3.134	126
I_2	3.134	126
I_3	1.440	58
I_g	3.123	126
$I_3 + I_g$	4.563	184

$a_1 = 103° 17'$ $a_2 = 76° 43'$ $a_3 = a_g = -120°$

This line was actually grounded when operating at 23,000 volts, and the current to ground, I_g, measured, and found to be 2.4 amp. Reducing the calculated value to 23,000 volts gives 2.176, or 90.7 per cent of the measured value.

Transmission Line B.—This example illustrates the effect of a ground wire. The system operates at 33,000 volts, 40 cycles, three phase, ungrounded. The conductors are No. 3/0 seven-strand, hard-drawn copper. The ground wire is ⅜-in. (95.2-mm.) diameter Siemens-Martin stranded-steel cable. The line is carried by suspension insulators on steel towers and is 21 miles (33.7 km.) long. The wires are transposed six times, giving the line two complete turns. Fig. 4 shows the wires, the spacing between the wires, and the spacing between the wires and their images. The data are given in Table II.

TABLE II—DATA ON TRANSMISSION LINE IN FIG. 4

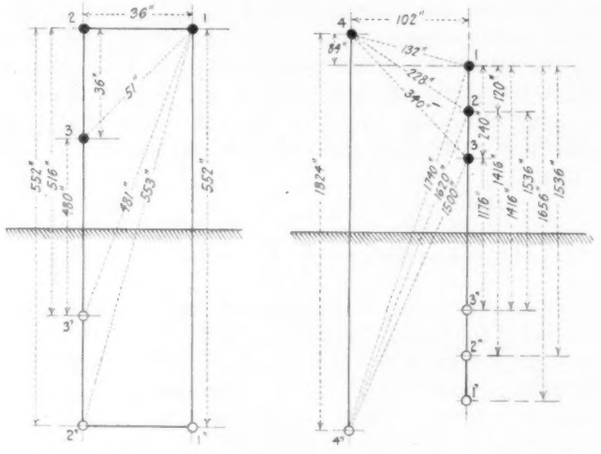
E	= 33,000 volts
V	= 19,050 volts
n	= 40 cycles
ω	= 251.3
l	= 21 miles
$a_1 = a_2 = a_3$	= .243 in.
a_4	= .187 in.
(1, 2) = (2, 3)	= 120 in.
(1, 3)	= 240 in.
(1, 4)	= 132 in.
(2, 4)	= 228 in.
(3, 4)	= 340 in.
(1, 1′)	= 1656 in.
(2, 2′) = (1, 3′)	= 1416 in.
(3, 3′)	= 1176 in.
(4, 4′)	= 1824 in.
(1, 2′) = (2, 3′)	= 1536 in.
(1, 4′)	= 1740 in.
(2, 4′)	= 1620 in.
(3, 4′)	= 1500 in.

From the data given:

$P_{1,1} = 3.8335$ $P_{2,2} = 3.7655$ $P_{3,3} = 3.6848$ $P_{4,4} = 3.9892$
$P_{1,2} = 1.1072$ $P_{1,3} = .7709$ $P_{1,4} = 1.1199$ $P_{2,3} = 1.1072$
$P_{2,4} = .8516$ $P_{3,4} = .6446$

Substituting these values in the formulas for the capacity coefficients of four conductors gives in farads per mile

$C_{1,1} = 1.210 \cdot 10^{-8}$ $C_{1,2} = -.1354 \cdot 10^{-8}$ $C_{1,g} = -.5585 \cdot 10^{-8}$
$C_{2,2} = 1.233 \cdot 10^{-8}$ $C_{1,4} = -.2608 \cdot 10^{-8}$ $C_{2,g} = -.5414 \cdot 10^{-8}$
$C_{3,3} = 1.193 \cdot 10^{-8}$ $C_{2,3} = -.2919 \cdot 10^{-8}$ $C_{3,g} = -.6711 \cdot 10^{-8}$
$C_{4,4} = 1.101 \cdot 10^{-8}$ $C_{2,4} = -.1444 \cdot 10^{-8}$ $C_{4,g} = -.6012 \cdot 10^{-8}$
$C_{1,2} = -.2553 \cdot 10^{-8}$ $C_{3,4} = -.0946 \cdot 10^{-8}$



FIGS. 3 AND 4—ARRANGEMENT OF CONDUCTORS FOR TWO TYPICAL CASES CONSIDERED

The charging currents are determined by the formulas for transposed conductors.

	Charging Current—Amperes	Charging Current—Per Cent of Normal
Normal current	1.448	100
Phase No. 3 grounded		
I_1	1.943	134
I_2	1.943	134
I_3	.686	47
I_4	.503	35
I_g	1.781	123
$I_4 + I_g$	2.284	158
$I_3 + I_4 + I_g$	2.970	205

$a_1 = 100° 10'$ $a_2 = 79° 50'$ $a_3 = a_4 = a_g = -120°$

This line was grounded and the current to ground, $I_4 + I_g$, found to be 2.95 amp., with a voltage of 32,160. The calculated value at this voltage is 2.226 amp., or 75.5 per cent of the measured value.

Conclusions

The agreement between the calculated charging currents and the measured values is not so good as could be desired. However, it does not appear so poor when the conditions which exist on any actual line, but which on account of their unknown amount have to be omitted in a calculation, are considered. One of the factors which affect the agreement between the calculated and measured values is the capacity of the transformers and

the line insulators. Another, and probably the most important one, is the presence of harmonics in the voltage wave. As charging currents are proportional to the frequency as well as the voltage, a small variation in the voltage wave from a true sine form will produce a decided increase in the charging current. Also the unbalanced charging currents in the grounded condition will tend to produce a distortion of the generator voltage which does not exist under normal conditions. However, the calculated values give a fair approximation of the actual values and probably show very closely the relative distribution of the currents between the various conductors and the ground.

LINE CONSTRUCTION COST

Data Presented in a Hearing Before Massachusetts Public Service Commission

Contract costs of setting and equipping transmission-line poles and stringing conductors were presented recently by Harold A. Ley, president of the contracting organization of Fred. T. Ley & Company, in the Boston Edison hearing before the Massachusetts commission. The data are given in accompanying tables. Although these costs are not "war prices," they are of interest as representing the normal amounts which must be paid for such work.

Ninety per cent of the work of the Ley company last year was done on a cost plus a percentage basis. The cost includes a profit figured from a sliding scale that ranges from 7.5 to 15 per cent, the former percentage applying where the total volume of business done in any one year for any one concern exceeds $1,500,000. Mr.

TABLE I—OVERHEAD-LINE CONTRACT UNIT COSTS

		Malden*	New Haven†	Boston‡
Setting:				
25-ft. poles		$2.50	$4.00	$2.25
30-ft. poles		2.50		2.25
35-ft. poles		2.75	4.25	2.50
40-ft. poles		3.50	4.75	2.90
45-ft. poles	One to four poles	8.50	6.75	4.00
	Five to nine poles	6.00	.....	.....
	Ten or more poles	4.50	.....	.....
50-ft. poles	One to four poles	10.00	8.50	9.00
	Five to nine poles	7.25	.....	6.50
	Ten or more poles	5.75	.....	5.15
55-ft. poles	One to four poles	11.50	11.00	10.35
	Five to nine poles	8.50	.....	7.65
	Ten or more poles	7.00	.....	6.30
60-ft. poles	One to four poles	13.00	13.00	11.70
	Five to nine poles	9 75	.....	8.80
	Ten or more poles	8 00	.....	7.20
65-ft. poles	One to four poles	16.00	16.00	14.40
	Five to nine poles	12.25	.....	11.00
	Ten or more poles	10.50	.....	9.50
Shaving and trimming		1.00	1.00	0.90
Gaining (per gain)		0.25	0.25	0.20
Stepping (per step)		0.05	0.05	0.05
Painting		0.05	0.05	0.04
Stenciling, with background		0.10	0.15	0.10
Hauling over 2 miles		0.50	0.50	0.30
Excavating, all sizes		1.50	.....	1.40
Setting, extra, for furnished walk		2.00	2.50	1.50§
Excavating rock and blasting (per pole)		7.50	10.00	6.75
Bolting or lagging cross-arms		1.25	1.65	1.50
Installing braces (each)		0.20	0.60	0.25
Installing long outrigger brace (each)		0.70	0.90	0.90
Installing insulators (each)		0.03	0.03	0.03
Installing magnetite-arc lamp or the like (each)		3.00	3.65	.....
Installing fixtures on incandescent lamp poles		.....	1.30 to 1.75	.....

*1913 prices. †1916 prices. ‡1914 prices. §Brick or block pavement only; concreting under post adds 33⅓ per cent.

TABLE II—UNIT PRICES FOR STRINGING WIRE AT MALDEN, NEW HAVEN AND BOSTON

Size of Equivalent Copper Conductor	Contract Price per 1000 Ft.		
	Malden	New Haven	Boston†
4-0 copper	$15.00	$16.30	$18.30
Aluminum	12.00	.....	14.60
3-0 copper	12.00	14.60	14.60
Aluminum	10.50	.....	12.90
2-0 copper	12.00	14.60	14.60
Aluminum	9.80	.....	11.95
1-0 copper	11.60	14.20	14.20
Aluminum	9.00	.....	11.00
No. 1 and under, copper	8.25	10.15	10.15
Aluminum	7.50	.....	9.15

*Includes putting up, tying in and connecting to existing overhead circuit, wires, taps, etc., but not connection to underground cables. †1914 prices.

TABLE III—UNIT COSTS OF VARIOUS LINE CONSTRUCTION OPERATIONS

	Malden	New Haven	Boston*
Hauling† slack for 1-0 and larger (per 1000 ft.)	$5.50	.....	$6.80
Hauling† slack for 1 and smaller (per 1000 ft.)	4.00	.....	4.80
Changing‡ 1-0 and larger (per 1000 ft.)	8.25	$10.15	10.15
Changing‡ 1 and smaller (per 1000 ft.)	6.85	8.40	8.40
Changing ties§ (per tie)	0.50	0.55	.....
Connecting drop wires to overhead (per ft.)	0.06	0.075	0.075
Connecting drop wires to underground (per joint)	0.70	.....	0.90
Installing guys from pole to two-way anchorage (per guy)	4.00	4.10	4.10
Installing guys from pole to three-way anchorage (per guy)	6.25	6.40	6.40
Installing guys from pole to four-way anchorage (per guy)	8.25	8.45	8.45
Removing guys of all kinds (per guy)	1.35	2.50	1.00
Changing guys (per attachment)	2.00	2.50	2.00
Cutting in strain insulators in existing guys (per insulator)	2.00	2.00	2.00
Planting guy anchor (rod and slug), per anchor	4.00	4.10	4.10
Installing anchor bolts in rock (per anchor)	2.00	2.00	2.00
Installing eye-bolts in pole or tree (per bolt)	0.70	1.00	0.75

*1914 prices.
†Includes untying, cutting, pulling up, jointing, tying in and changing as required.
‡Covers changing tie wires on account of work on pins, insulators or cross-arms.
§On account of change of work on pins, insulators, cross-arms or poles, including care and temporary support of wires during work.

Ley said that a 15 per cent profit is figured on jobs where only labor items enter. The overhead cost of small tools, etc., is taken out of the 15 per cent. Liability insurance on overhead work now amounts to 6 per cent. The cost of digging implements, blasting tools, spikes, pole-raising equipment, ropes, come-alongs, rubber gloves, pliers, etc., figures 3.5 per cent of the payroll.

Roughly, 25 per cent of the work of the Ley organization is for public service corporations. The unit prices charged in different contracts depend on local conditions. A small job under competitive conditions naturally calls for a higher unit price. Mr. Ley said that in 1907 he paid $1.50 per ten-hour day for common labor with no allowance for holidays and rainy days. Linemen then received $2.75 for nine hours' work on the job. In 1914 common labor was paid about $2 for nine hours, and linemen were paid $3.50 for nine hours' time, traveling one way on their own time and being paid by the Ley company for holidays and all rainy weather. Common labor is now paid on holidays and in bad weather. At present linemen are being paid $4.50 for nine hours and common labor demands about 30 cents per hour. Nothing like the amount of work of ten years ago is to be obtained from men to-day.

Regulation with V-Connected Transformers

Variation of Secondary Terminal Voltage with Various Combinations of Load Impedance and Power Factor—Effect of Phase Rotation on Secondary Voltage

BY LESLIE F. CURTIS
University of Washington, Seattle

TO DETERMINE the effect of phase rotation and various load conditions and power factors on the secondary terminal voltage of V-connected transformers an investigation* was conducted under the supervision of the writer, the conclusions from which are given herewith. The method of conducting the study follows:

In order to simplify the work, a vector diagram

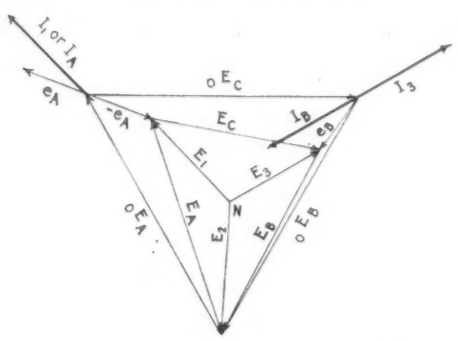


FIG. 1—GENERAL CASE FROM WHICH SOLUTIONS FOR VECTOR LOAD CURRENTS AND LINE VOLTAGES WERE DERIVED

(Fig. 1) was chosen, indicating a general case, and from this equations were developed which give general solutions for the vector load currents and line voltages. In these general equations values of transformer and load impedances were substituted and numerical values of secondary line voltage found for the following conditions: (1) Balanced load impedances for all the phases; (2, 3, 4) equal load impedances for the first and second, first and third and second and third phases respectively; (5, 6, 7) first, second and third phases respectively loaded alone. Curves of the three terminal voltages were plotted against power factor for each of the seven cases given. The load impedances were so selected in each case that the maximum transformer current would be 150 per cent of full-load current at full voltage.

The calculations were made as follows: Let the primary voltages of the three phases, from line 2 to line 1, line 3 to line 2, and line 1 to line 3, respectively, be expressed as follows (readers will please note that vector symbols are indicated by roman letters (E, I, Z, e) in contradistinction to the italic symbols employed in all other cases):

$$_{o}\mathrm{E}_{a} = E\ (-0.5 + 0.867j) \quad (1)$$

$$_{o}\mathrm{E}_{b} = E\ (-0.5 - 0.867j) \quad (2)$$

and $$_{o}\mathrm{E}_{c} = E \quad (3)$$

where E is the effective value of the primary voltage, and j indicates a rotation of 90 deg. in a counter-clockwise direction, which is taken as positive. The phase rotation is therefore *A-C-B*.

Assuming that transformers of impedance Z_a and Z_b are placed across phases *A* and *B*, and that the secondaries are loaded with star-connected impedances Z_1, Z_2, and Z_3, terminating in lines 1, 2 and 3 respectively, the drop in transformer *A* is expressed by

$$e_a = Z_a I_a \quad (4)$$

where I_a is the current through it. Likewise the drop in transformer *B* is

$$e_b = Z_b I_b \quad (5)$$

If I_1, I_2 and I_3 represent the currents in lines 1, 2 and 3 respectively, and E_1, E_2 and E_3 the respective voltages to neutral, then

$$E_1 = Z_1 I_1 \quad (6)$$

$$E_2 = Z_2 I_2 \quad (7)$$

and $$E_3 = Z_3 I_3 \quad (8)$$

Obviously, as in any system,

$$I_1 + I_2 + I_3 = 0 \quad (9)$$

and the relations between the transformer and line currents are as follows:

$$I_a = I_1 \quad (10)$$

and $$I_b = -I_3 \quad (11)$$

The secondary terminal voltage of transformer *A* may be expressed as

$$E_a = E_1 - E_2$$

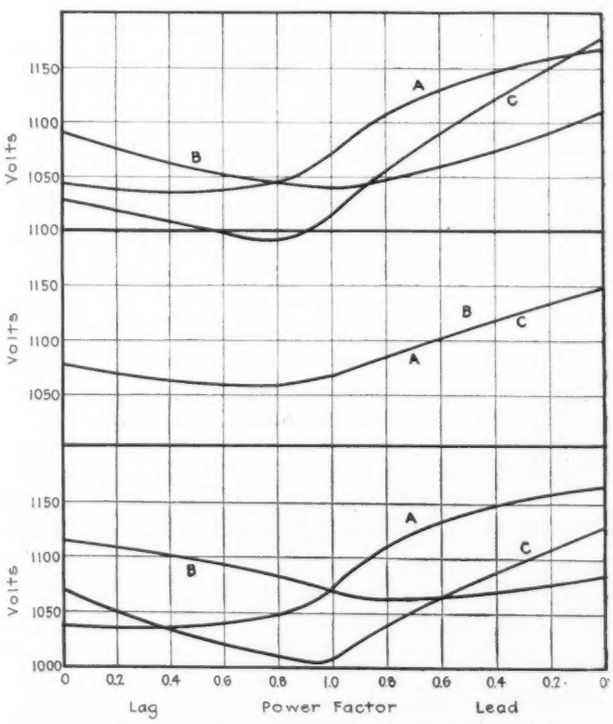


FIG. 2, 3 AND 4—APPLICATIONS OF CASES I, II AND III

which, by substituting (6) and (7), becomes

$$E_a = Z_1 I_1 - Z_2 I_2 \quad (12)$$

The terminal voltage of transformer *A* may also be expressed from (1) and (4) as $E_a = E\ (-0.5 + 0.867j) - Z_a I_a$. Substituting (10) in this equation, it becomes $E_a = E\ (-0.5 + 0.867j) - Z_a I_1$ (13)

*The author is indebted to Verne Hansen for work done on a thesis on the above topic published under the author's direction at the University of Washington (Seattle) in 1915, and to B. F. Jakobsen's paper in the ELECTRICAL WORLD in 1915. Mr. Hansen's work showed experimentally the results obtained by calculation in the present article.

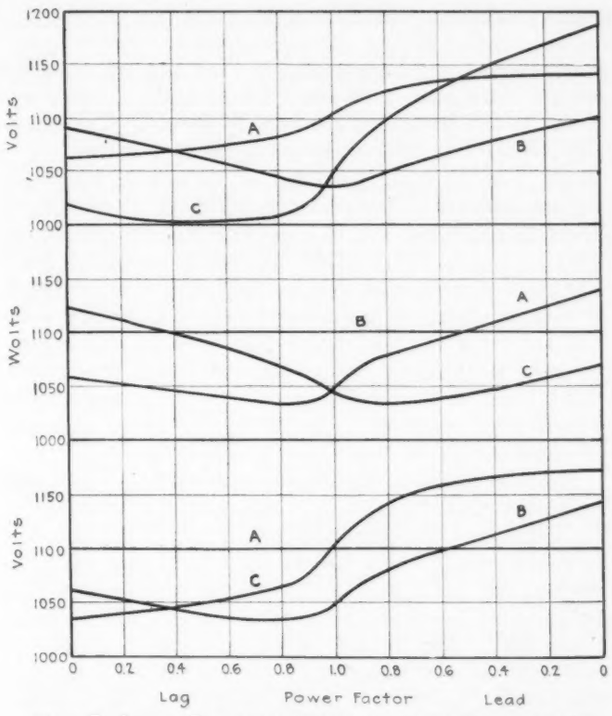
Equating (12) to (13), substituting the value of I_2 from (9) and transposing, gives

$$I_1 (Z_1 + Z_2 + Z_a) + Z_2 I_3 = E (-0.5 + 0.867j) \quad (14)$$

In a like manner from (7), (8), (2), (5), (11) and (9),

$$I_3 (Z_3 + Z_3 + Z_b) + Z_2 I_1 = E (+0.5 + 0.867j) \quad (15)$$

Equations (14) and (15) are simultaneous in I_1 and I_3



FIGS. 5, 6 AND 7—APPLICATIONS OF CASES IV, V AND VI

and are readily solved on substituting the respective values of Z and E.

The third line current is then found from (9) to be $I_3 = -I_1 - I_3$, and the three line voltages from (12) are

$$E_a = Z_1 I_1 - Z_2 I_2,$$
$$E_b = Z_2 I_2 - Z_3 I_3,$$

and

$$E_c = -E_a - E_b.$$

APPLICATION OF GENERAL EQUATIONS

Applications of the general equations are given below. In each case 10-kw., 1100-volt transformers of equal impedance $(4 + 3j)$ ohms are assumed to be operating with load impedances giving all power factors for the seven cases noted below.

Case I. Three Balanced Load Impedances.—The effective value of the impedances to neutral for 150 per cent of normal rated load current at normal voltage is

$$\frac{1100}{\sqrt{3}} \times \frac{1100}{10{,}000 \times 1.5} = 46.5 \text{ ohms.}$$

The vector quantities corresponding to this effective value at various power factors are

+46.5 ohms at unity power factor,

+46.5j ohms at zero power factor lagging,

−46.5j ohms at zero power factor leading,

and

+46.5 $(0.5 + 0.867j)$ ohms at 0.5 power factor lagging, etc.

Substituting these values in the general equations gives effective values for E_a, E_b and E_c which are plotted against power factor in Fig. 2.

Case II. Phases A and B Loaded.—In this case Z_3 equals zero. The effective values of the impedances Z_1 and Z_3 are $\frac{\sqrt{3} \times 1100 \times 1100}{10{,}000 \times 1.5} = 140$ ohms. As in case I, the vector values are substituted and curves of terminal voltage are plotted in Fig. 3.

Case III. Phases A and C Loaded.—This is the same as case II, except that Z_1 instead of Z_2 equals zero. (See Fig. 4.)

Case IV. Phases B and C Loaded.—This is the same as case II, except that Z_3 instead of Z_2 equals zero. (See Fig. 5.)

Case V. Phase A Loaded.—In this case the effective value of the impedance Z_1 for 150 per cent of normal rated current at 1100 volts is $\frac{1100 \times 1100}{10{,}000 \times 1.5} = 80$ ohms. Z_2 equals zero and Z_3 equals infinity. (See Fig. 6.)

Case VI. Phase B Loaded.—This is the same as case V, except that the effective value of Z_3 is 80 ohms, Z_2 is zero and Z_1 is infinity. (See Fig. 7.)

Case VII. Phase C Loaded.—This is the same as the last two cases except that the effective value of Z_3 is 80 ohms, Z_1 is zero and Z_2 is infinity. (See Fig. 8.)

CONCLUSIONS

With balanced load impedances at unity power factor, (Fig. 2), it will be noted that the terminal voltages are highest on phase *A* and lowest on phase *C*. The terminal voltages of the two transformers (phases *A* and *B*) are dependent upon the vector drops of voltage in them. The unbalance is then due to the fact that the current in transformer *A* leads the supply voltage on that phase by a small angle, thus having a tendency to boost the terminal phase voltage, while the current in transformer *B* lags behind the supply voltage for that phase, thus having a tendency to lower the terminal phase voltage. The angles of lead and lag noted above will not be just 30 deg., since the terminal voltages are unsymmetrical, giving load currents unbalanced both in effective value and in phase position. The vector relations between the losses in voltage noted are such that the terminal voltage of phase *C* is lowered most of all.

The relations at other power factors and loads may be explained in a similar way. The conditions of loading chosen are perhaps abnormal, or at least the worst

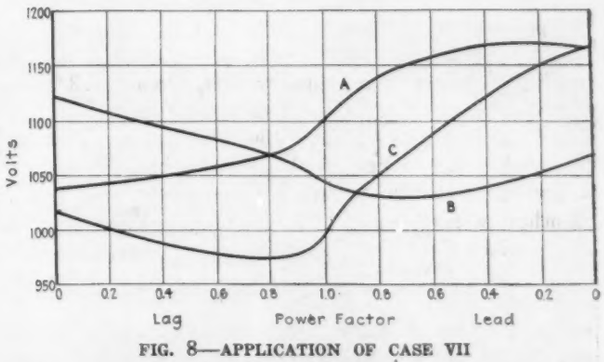


FIG. 8—APPLICATION OF CASE VII

that will ever be met in practice, but show the unbalance of terminal voltage which may be expected with the open-delta or V connection of transformers.

It may be noted that there is a wide variation between the three line voltages in the examples given. An exception is found in case II (Fig. 3), where the terminal voltages of all three phases are alike.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SELECTING CLAY FIREBRICK

Advantages and Uses of Various Types—Their Resistance to Heat

First-quality hand-made brick should be used where the temperature is high and variable and the heating and cooling are sudden and rapid. A good hand-made brick should be coarse in texture, light buff in color, with no iron spots, and should give a slight ring when struck. The face of a fracture should be rough and coarse-grained. Hand-made brick is highly refractory, expands only slightly under high heat and resists sudden changes of temperature, but wears away rapidly under abrasion. The dry-press grade is almost as refractory as the hand-made, and expands only a little more, resists sudden changes of temperature fairly well and stands up better under mechanical action. The steam-press grade is less refractory and breaks down under sudden changes of temperature, but resists abrasion better than either of the other types mentioned.

UNLOADING COAL FOR EMERGENCY STORAGE

Method Described Found Satisfactory and Cost Much Less than That of Any Method of Digging Coal from Cars

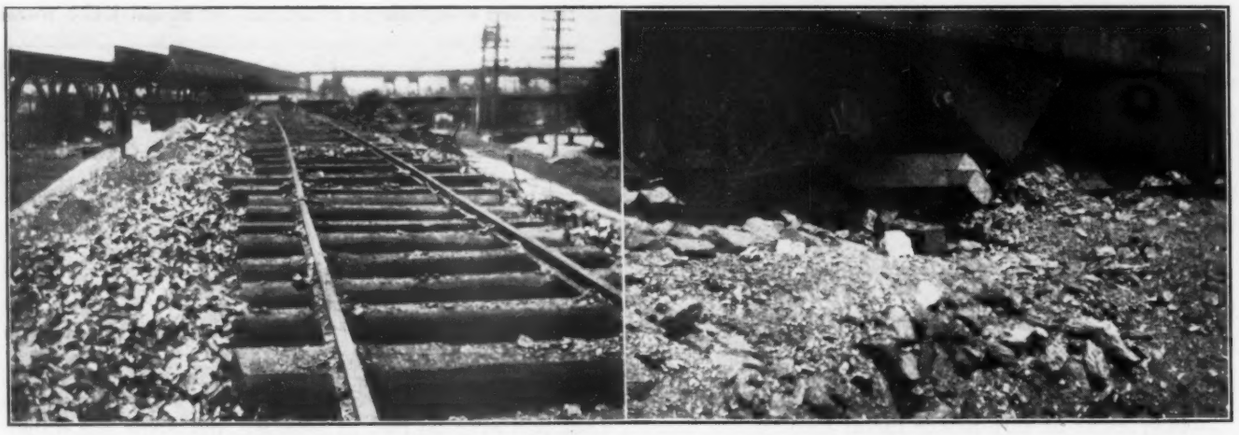
BY WILLIAM C. BELL

Assistant General Superintendent Light and Power, Virginia Railway & Power Company

In storing coal in quantities, in excess of the normal storage and bunker capacity, the cost of unloading and reloading is apt to be excessive. A method which has the advantage of low cost and relatively great speed has been used by the Virginia Railway & Power Company. This consists of building standard-gage railway tracks on 8-ft. (2.4-m.) ties, spaced on 4-ft. (1.2-m.) centers. Coal in straight hopper-bottom cars or twin drop flat cars is then pushed on these tracks and the unloading doors in the bottom of the car are opened. The coal is deposited over the tracks and between the ties.

An 8-in. by 8-in. (20.3-cm. by 20.3-cm.) timber inserted in front of the rear trucks serves to spread out the coal and clear the track sufficiently for the empty car to be removed. After the entire length of track has been covered with coal in the manner described, it is only necessary to use ordinary track jacks and raise the track on the coal which has been previously unloaded. If 12-in. by 12-in. (30.5-cm. by 30.5-cm.) timber is used as ties, a 50-ton (45-t.) car of coal can be unloaded in from 50 ft. to 75 ft. (15 m. to 22.5 m.) of track.

It has been found inadvisable to build up a coal track higher than 10 ft. or 15 ft. (3 m. or 4.5 m.), owing to the danger of spontaneous combustion. When the coal pile has reached this height, it is only necessary to reconstruct the track, beginning on the ground and building up a second pile. For reclaiming the coal, the track is constructed on the ground alongside the coal pile, the coal being dug from the pile by a locomotive crane. As the coal is removed the track is moved sideways to keep the locomotive crane at a proper distance from the coal pile. Standard railway cars are used to transfer the coal from the coal pile to the coal-handling equipment. It has been possible with this method to unload from 400 tons to 500 tons (360 t. to 450 t.) of coal per eight-hour working day on 200 ft. (61 m.) of track. This method can only be used when a locomotive is available, inasmuch as considerable power is required to pull the coal cars after they have been dumped.



FIGS. 1 AND 2—TRACK IS JACKED UP AFTER COAL IS UNLOADED; SILL PLACED IN FRONT OF CAR WHEELS TO DISTRIBUTE COAL

The illustrations explain the method, which has been used extensively in unloading ballast for steam roads, and works out as well with coal as with gravel and other ballast.

FAULT IN ELECTRIC FURNACE CONTROL WIRING REMEDIED

Unsuitable System of Control Connections and Method Adopted by a Northern Steel Mill for Rectifying It

When the first of a recently installed battery of Heroult steel furnaces was placed in service in a Northern steel mill, great difficulties were experienced in its regulation and the maintenance of a balanced current either by hand or automatic regulation was found

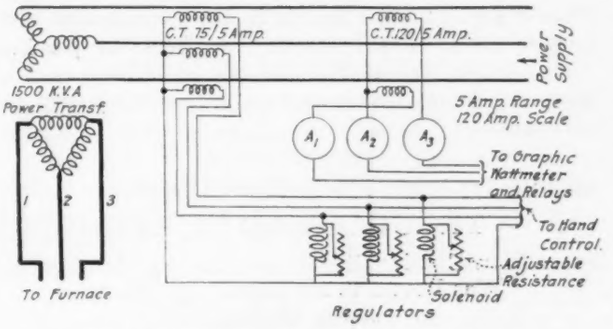


FIG. 1—WIRING BEFORE CHANGE WAS MADE

almost impossible. A balanced reading being obtained on the ammeter, the condition was most unstable, and an increase of current in one line was as likely as not to be further increased by raising the corresponding electrode out of the bath.

The arrangement of the wiring was compared with the diagrams supplied and, as far as was possible, it was found to check perfectly and to be as shown in Fig. 1. The ammeter readings were found to be proportioned to the currents in the regulator coils, and the graphic wattmeter circuits were normal. Some time was taken in determining the connections of the 1500-kva., three-phase transformer, and this was found to be star-delta. It will be seen that with such an arrangement the currents in the ammeters and regulators will not of necessity be proportional to those in the electrodes, for the current in each electrode is the resultant of the currents in two secondary windings of the transformer, which are in turn proportional to those in two of the primary lines. As this system was manifestly useless for control purposes the problem became one of getting significant currents in the meters and

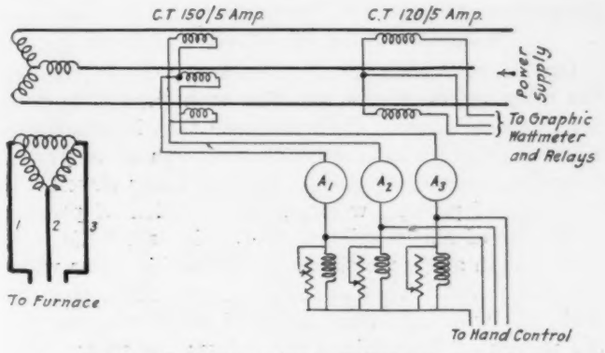


FIG. 2—WIRING AFTER CHANGE WAS MADE

regulators and of doing this, if possible, without allowing the furnace to cool.

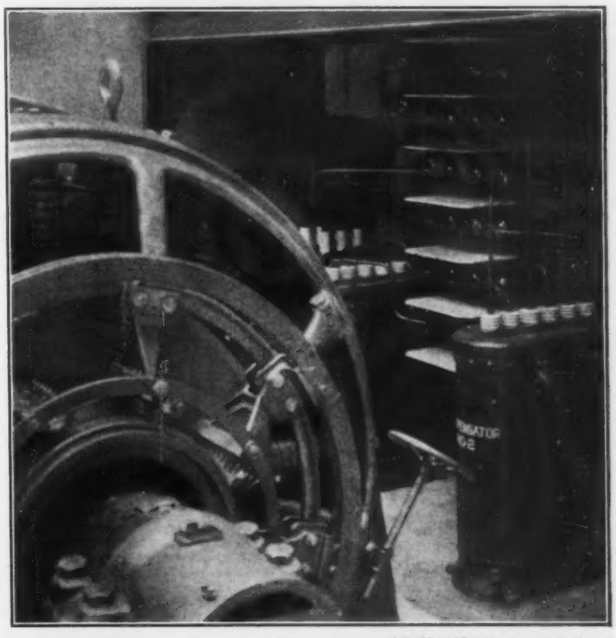
A reconnection of the power transformers was out of the question both for electrical and mechanical reasons. Series transformers for the secondaries were suggested, but such transformers suitable for 10,000 amp. could not be purchased or made at short notice.

The problem had a simple solution: The three 75/5 current transformers on the regulator circuits were replaced by 120/5, of which a considerable number, intended for the meter circuits of the other furnaces, were on hand. The secondaries of these were connected in delta, thus duplicating the power wiring; the ammeters were placed in series with the regulators and the wiring was left as in Fig. 2. With these changes made, the furnace was found to operate normally, whether on hand or automatic regulation, and the arrangement was adopted for the other furnaces which were being installed, though it was found desirable to replace the 120/5 current transformers by 150/5 ratio to get more suitable currents in the ammeter and regulator windings.

MAKING TWO COMPENSATORS SERVE A SUBSTATION

Methods of Connecting One Compensator and a Spare to Serve as Starters for Several Motor-Generator Sets

In some of the substations of the Pacific Gas & Electric Company at San Francisco where several motor-



SWITCHES THAT PERMIT USING EITHER OF TWO COMPENSATORS TO START MOTOR-GENERATOR SETS IN STATION

generator sets are installed it has been found that a considerable investment can be saved by starting all machines from one compensator. This had the objection, however, that in case the compensator should become inoperative for any reason starting of any machines would be prevented. Two compensators are therefore installed and connected by six double-throw single-pole knife switches, as shown above.

This arrangement makes it possible to use either compensator for starting any number of machines of the same rating. Since the knife switches would necessarily be de-energized when operated, there is no necessity for additional oil switches.

OUTDOOR SUBSTATIONS OF SOUTHERN COMPANY

Inexpensive but Substantial Method of Construction Followed in Providing for the Needs of Large Power Consumers

BY N. NESBITT TEAGUE
Augusta-Aiken Railway & Electric Corporation, Augusta, Ga.

Outdoor substations constructed as simply as possible, inexpensively, but at the same time untilizing a good grade of material, are employed by the Augusta-Aiken

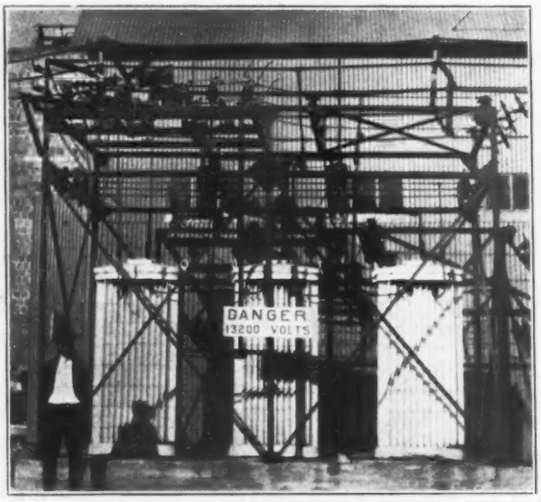


FIG. 1—STANDARD 13,200-VOLT OUTDOOR SUBSTATION

Railway & Electric Corporation for serving large power users. In the average-size installation one, two or three poles are used generally, as shown in Fig. 2. In special

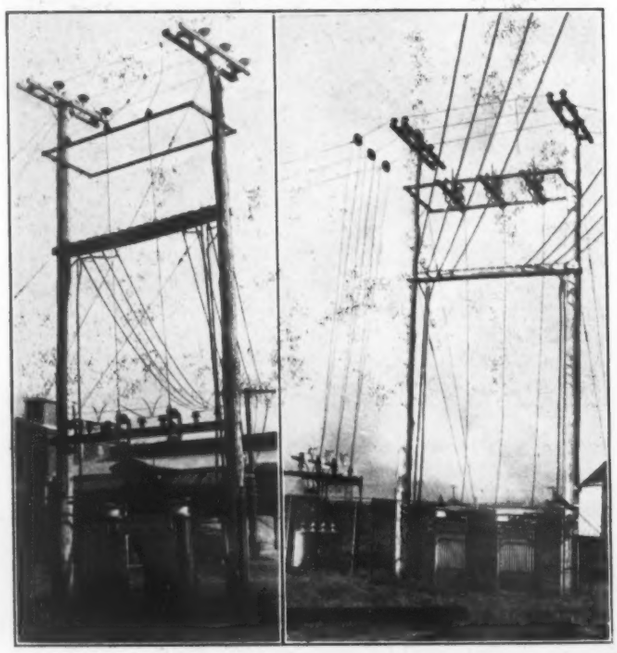


FIG. 2—TWO TYPES OF STANDARD WOOD-POLE SUBSTATION

cases on large installations the use of steel angle-iron framework is employed for supporting the switches, fuses, busbars and meter. The transformers in all cases are placed as near the ground as possible, and when small wood-pole structures are used the transformers are placed directly on the ground, a few old rails embedded in the earth serving as a foundation. This practice makes it convenient to replace or remove transformers. Transformers are raised only when there is occasion to locate the apparatus on some public street. Fences are provided around the transformers, wires, etc., to protect the public and also animals. Metering is accomplished on either the high-tension or low-tension side of the transformers, as conditions require, and generally with outdoor home-made housing such as described on page 1262 of the June 30, 1917, issue of the ELECTRICAL WORLD. The cost of the substations, rated from 300 kva. to 900 kva., with steel framework, electrolytic arresters, etc., varies from $4 to $6 per kva. This work is carried on under the supervision of J. J. Borger, general superintendent of the electrical department.

MOTION-PICTURE MACHINE TROUBLE EASILY REMEDIED

Fuses Blew Continually—Upon Investigation Trouble Was Found to Be Caused by Use of Short Carbons

BY J. R. BALDWIN

A motion-picture theater had trouble owing to the blowing of the 60-amp. fuses in the arc-light circuit of the picture machine and the 100-amp. main-line fuses. The arc was controlled by an old-type Edison controller and a 110-volt, 30-40-60-amp. "Compensarc." A contractor was called in and he reinsulated the carbon holders and finally held the current down by connecting two "Compensarcs" in series.

Tests made by an inspector showed that the 60-amp. fuses would blow with one "Compensarc" connected, and this occurred when the carbons were touched together to draw an arc. Both of the carbons were short, and when new long carbons were put in the trouble ceased. The customer had recently changed the style of carbons, having bought soft flaming carbons when he had been using hard ones. The new carbons had a comparatively lower resistance. On the modern style of picture machines the short carbons are used with long ones, the arc being brought to the correct position by having a long vertical adjustment.

POLES IN PAVED ALLEYS

Protection Should Be Provided from the Hubs of Wagons Guided by Careless Drivers

One large Middle Western company is considering the adoption of a new practice with regard to poles set in paved alleys. It is proposed that in the future all such poles be installed with mud guards to protect them from damage caused by the pole being struck with the hubs of passing wagons. Observation of poles in a number of alleys indicates that this damage is more prevalent in alleys which are paved than in those which are not paved. This probably results from the fact that ruts wearing in the unpaved alleys tend to keep the wheels of the vehicles away from the poles. This is a rather fortunate circumstance, because it is not desirable to install guards on poles set in unpaved alleys, since the guards may become useless at a later time when the alley is paved and the grade is changed. Guards used in paved alleys will last a long time.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

KEEPING ELECTRIC FLATIRON USERS IN A SATISFIED STATE

Company Suffers No Loss of Revenue Because It Loans Irons to Customers While Their Defective Ones Are Being Repaired

Realizing the value of electric flatirons as revenue producers, the Commonwealth Electric Company of Summit, N. J., will not allow a flatiron customer to be without flatiron service for twenty-four hours if it can be helped. Customers are urged to bring in their irons whenever they are out of order for repairs. While the iron is undergoing repairs another iron is loaned to the customer by the company until the damaged one is made serviceable. The "loaners," as they are called in the company's office, are old irons which customers believed could not be repaired satisfactorily. The company, not wishing to antagonize the customer, takes such irons as part payment for new ones and at small cost renders them serviceable again. These irons are in excellent condition, and while they may not have all the appearance of new ones, they serve the purpose remarkably well.

WHERE COOKING EQUIPMENT CAN BE SOLD ON COST ALONE

Cases Wherein Electricity Actually Is Cheaper Than Wood or Coal for Cooking in Country Club and in Public Institutions

From three electric kitchens in the suburban territory outside St. Louis, Mo., has come the information that for certain classes of cooking at least electricity is actually cheaper than the more ordinary fuels. These kitchens are at the Belle Rives Country Club, at St. Vincent's Institution for the Insane, and at the Marellac Seminary. These places are all served from the lines of the Western Light & Power Company at a 2-cent cooking rate. The information regarding the installations and the costs was supplied by C. B. Kennedy, sales manager for the Light & Development Company of St. Louis,

FIG. 2—A 51.6-KW. KITCHEN WHICH SAVES THE COUNTRY CLUB $500 A YEAR

which is the parent organization of the Western Light & Power Company.

In the case of the Belle Rives Country Club it was formerly necessary to start fire in the coal range at 5 o'clock in the morning and to keep the stove red-hot until 1 o'clock on the following morning. To let the fire die down was to court trouble, because guests were likely to arrive and want immediate service at any hour. Moreover, it was necessary to keep one man solely to carry coal and to remove ashes. The fuel, which was hard coal, was costing $75 a month, and the labor incidental to handling coal and ash amounted to $27 a month. By changing to a complete electric cooking equipment it was possible to eliminate enough of this sort of waste to effect a net annual economy of $500.

FIG. 1—EXTERIOR OF THE BELLE RIVES COUNTRY CLUB

The club's electric installation, preparing food for about 200 people a day, consumes on the average 3000 kw.-hr.

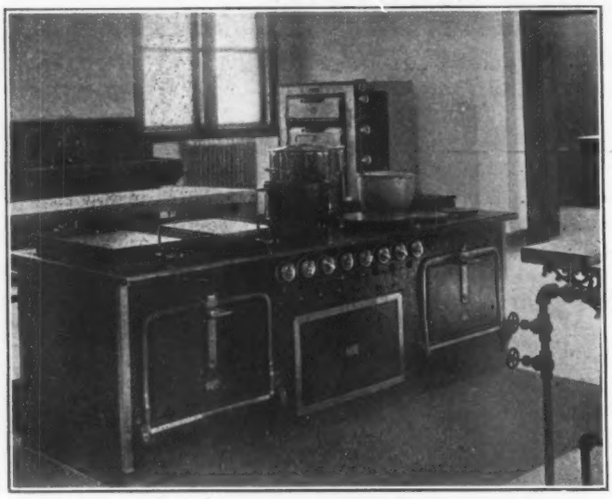


FIG. 3—SIMPLEX RANGE AND HUGHES BAKE OVEN WHICH DO MOST OF THE COOKING AT MARELLAC SEMINARY

a month, making the electricity cost $60. Here is a list of the electrical equipment which the club purchased:

	Watts
One Hughes range:	
Four top burners, rated at 4000 watts each	16,000
Six top burners, including two broilers, rated at 2200 watts each	13,200
Four ovens, each rated at 3600 watts	14,400
One electrified steam table.	
Four Hughes immersion-type water heaters, 2000 watts each	8,000
One Hughes electric bake oven with a capacity of 91 loaves each 20 minutes	10,000
One electric refrigerator	185
Total	61,785

This kitchen has sufficient capacity to care for about 300 people per day. One of its interesting features is the electrified steam table, which was converted from an ordinary steam table by inserting the immersion heaters

FIG. 4—TWO BAKE-OVEN INSTALLATIONS—AN ELECTRIC AND AN OLD-STYLE WOOD-FUEL OVEN

The little electric oven has twice the hourly baking capacity that the wood-fuel oven has and fills only a fraction of the space.

and lining the bottom of the tank with a 2-in. (5.08-cm.) magnesia covering.

At the two public institutions the energy consumption per person is not so high as it is at the country club. The club uses about 100 kw.-hr. to serve 200 people a day. The Marellac Seminary uses about 83 kw.-hr. to serve 300 people a day. The St. Vincent's Institution uses about 90 kw.-hr. to serve 450 people a day. At the seminary everything is cooked electrically, using Simplex and Hughes ranges and Hughes bake ovens. At the public institutions there is no water-heating load.

All of the installations are giving satisfactory service. Of the one at the country club this seems particularly true. The favorable viewpoint of the stewardess of this club, Mrs. C. W. Mason, on electric cooking, is shown by her letter reproduced herewith:

Mr. C. B. Kennedy, Sales Manager Western Power & Light Company, St. Louis, Mo.

Dear Sir—In reference to the electric range and bake oven installed at the Belle Rives Country Club, will say that we are very much pleased not only with the cost of operation, but with the general conditions, which were materially changed for the better through electric cooking.

Prior to the time we installed the electric range it was necessary to keep fire in our large coal range from 5 a. m. until after 12 o'clock midnight, so as to be ready at any time to serve meals. Through the use of the electric range we are able to turn on just sufficient heat to cook whatever is required.

One of the advantages we have derived through the use of this electric equipment is that we may now use the rooms directly over the kitchen, which we could not use for club members owing to the excessive amount of heat from the old-type range.

Our bake oven and electric steam table are very satisfactory, and we have no hesitancy in recommending the use of an electric range for hotel and club purposes.

Very truly yours,

Mrs. C. W. Mason,
Stewardess.

SERVICE A MEASURE OF PUBLIC UTILITY INCOME

When, for Any Reason, a Company Fails to Furnish Service Required by Its Patrons, Its Income Ceases and Its Expense Continues Unabated

The *Southern Public Utilities Company Magazine* for Aug. 10, published at Charlotte, N. C., contains an editorial on the economics of service which indicates how the utilities managed from that center regard their obligations to their patrons as well as stockholders. It reads in part as follows:

No revenue accrues to a public utility company except when that company is providing and furnishing service.

And the moment that such a company ceases or fails to furnish service to its customers, it not only ceases to receive a revenue, but is actually losing income—not only from the fact that the customer is paying nothing for service he is not receiving, but also by reason of the fact that interest charges, labor charges, depreciation and many other items of expense continue.

Therefore, when for any reason a company fails to furnish service required by its patrons, its income ceases, and its expense continues in at least as great volume, and in many instances greater than when service is being furnished.

In other words, should a street railway car in service on the line stand idle for lack of electricity, the inconvenience and loss of time and money do not lie solely on the patron who desires to make use of that service in the transaction of his business, but the revenue from that car ceases, the wage schedule for every employee connected directly or indirectly with the operation of that car continues, the interest charges on the investment in equipment, roadway, power generation and transmission systems and many other charges continue unabated.

This is likewise true in the matter of lighting. When, for any reason, service is interrupted, the company suffers in loss of dollars and cents in direct ratio to the inconvenience occasioned to its patrons. The moment service is interrupted the disk in the meter which measures the energy used by the consumer comes to a standstill, and when this occurs the income to the company ceases.

Therefore, it is to be easily seen and realized that power interruption, failure to maintain service, even momentarily, is a distinct financial loss to the company, not considering the inconvenience and money loss to customers depending upon that service.

For this reason, when an interruption of power occurs which necessitates a failure of service, every resource at the command of the company is put into action to restore such service immediately, and if this is not practicable to resume service with the least possible loss of time.

To the patron sitting in his home in the evening, enjoying association with his family, the failure of the lighting system is a source of annoyance calculated to exasperate the most even-tempered. But to the company such a failure is not only a great inconvenience, but—not taking into consideration the extra expense of restoring service within the shortest possible time—the company is standing a very real and decided financial loss until such service is again restored.

There is no patron of any public utility company more anxious that the company maintain uninterrupted service 365 days in the year, year in and year out, than the company to which he looks for this service. It is the sole and single purpose of public utility companies to furnish maximum service at all times, in the most pleasant and satisfactory manner possible, to the customer; and when for any reason failure occurs it is not only a source of deep regret to the company, but it is a direct and effective blow at its earnings.

It is the business of such a company to keep the disks of its electric meters revolving every moment there is a demand on the part of its customers. If, for any reason, failure is registered in this function, it means a serious curtailment of the company's earning powers.

To the patron a service interruption means the failure of lamps in a given building, or delay to a specific car, involving only a few, with a small relative loss of money. But to the company such an interruption means the aggregate of thousands of customers, each of whom is being inconvenienced as greatly as all others, so that the company feels exceedingly keenly the multiplied exasperations which come to all customers; and while the individual regrets the failure of the company to maintain absolutely perfect service under any and all circumstances, the company itself faces with mortification each such incident.

INDUSTRIAL HEATING DEVICES IN CHICAGO

Comparative Figures for 1916 and 1917 Show Marked Increase in Connected Load of Appliances Owing to Installation of Large Units

A census of electric industrial heating devices on the lines of the Commonwealth Edison Company, completed July 1, 1916, showed the staggering total of 33,270 devices with an aggregate rating of 23,857 kw. In the thirteen months which have elapsed since that time the number of devices in service has increased about 3000 and the connected industrial heating load has increased 14,500 kw. The heavy increase in connected load as compared with the increase in number of devices is attributable to the addition of arc furnaces and such other large industrial applications. Among the smaller articles the commercial flatiron and the glue pots still remain most popular. It is an interesting fact that in such a comparatively recent development as electric heating only two new applications have been connected in the last year. In more normal times this might be taken to indicate that the development period was past. But in these strenuous times it is perhaps more accurate to conclude that it signifies, if anything, that energies are all directed toward producing standardized goods and no time or effort can be spared for development. That the electric heating industry is going forward on all fronts is evident from the fact that in every case there are as many, and in 96 per cent of the applications there are more, devices in service now than there were one year ago.

The table printed herewith lists fifty different electricity-consuming devices, varying in number from commercial flatirons, of which 25,850 are in use, to tempering baths and monotype pots, of which only two each are recorded.

INDUSTRIAL HEATING APPLIANCES IN CHICAGO

Device	1916 Number	1916 Kw.	1917 Number	1917 Kw.
Anealing furnaces*	....	....	4	240
Air heaters (industrial)	40	46	156	161
Baking installations	10	127	13	142
Bacteriological ovens	7	6	14	13
Branding irons	80	28	192	75
Beer-vat dryers	11	33	12	36
Can cappers	105	36	124	49
Commercial flatirons	25,000	17,000	25,850	17,610
Coffee urns (commercial)	9	14	22	35
Disk stoves (industrial)	700	385	1,340	1,190
Drying ovens	7	18	38	101
Enameling ovens	5	603	13	638
Embossing presses	11	17	12	18
Extract heaters	70	139	107	268
Furnaces (resistance)	18	38	32	126
Film dryers	13	27	13	27
Furnaces (arc)	4	2,680	13	14,000
Furnaces (electrolytic)*	....	....	6	240
Glue pots	5,000	1,150	6,200	1,380
Glue cookers	15	72	17	81
Glue-heating installations (special)	54	37	88	67
Immersion coils (liquid heating)	150	170	215	202
Ink dryers	160	96	235	141
Linotype pots	21	36	24	38
Liquid-heating installations (special)	65	72	82	94
Metal-melting pots	5	11	6	16
Material heaters	36	57	62	118
Monotype pots	2	4	2	4
Printing-press dryers	7	11	7	11
Putty-warming machines	5	9	7	12
Pleating machines	6	7	9	11
Photo-print dryers	4	8	18	22
Pyrographic machines	5	29	5	29
Photo-chemical bath heaters	7	13	21	36
Popcorn machines	14	35	19	47
Roofing-machine heaters	4	29	5	36
Radiant heaters (industrial)	240	144	356	202
Sealing-wax heaters	200	40	278	59
Sterilizers	90	40	104	49
Soldering irons	750	150	920	192
Soldering-iron furnaces	30	18	35	49
Solder pots	9	5	15	8
Tempering ovens	2	9	19	91
Tempering baths	1	7	2	14
Toasters (commercial type)	27	82	68	206
Vulcanizers (industrial)	18	14	35	26
Varnish heaters (spraying)	175	105	335	185
Wax-knife heaters	34	9	43	12
Wax heaters	32	7	37	9
Waffle irons (commercial type)	12	12	23	23
	33,270	23,857	36,251	38,239

*New applications.

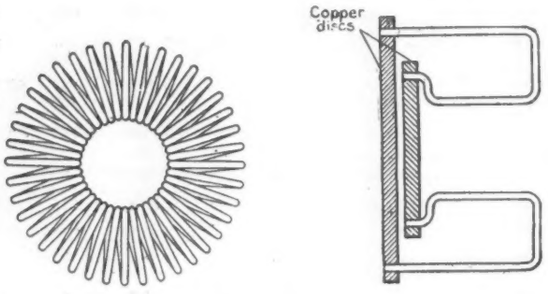
ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

WATTMETER FOR DEALING WITH HIGH LOAD CURRENTS

New Concentric Standard Dynamometer Wattmeter for Heavy Currents and Concentric Non-Inductive Standards of Low Resistance Described

THE object of the work carried out by A. E. Moore in an article in the July 6 issue of the *London Electrician* was to provide, in the standardizing laboratory at the School of Technology, Manchester, a precision watt standard for dealing with load currents of upward of 1000 amp., suitable for the verification of sub-standard and other wattmeters and watt-hour meters, etc. A Kelvin watt balance for currents up to 1000 amp. was obtained, but neither this nor other balances fulfilled the necessary requirements exactly, and in the meantime the author had in mind a form of current coil which appeared to be worth developing for a dynamometer-type wattmeter.



FIGS. 1 AND 2—CLOSED RING WINDING; HOW TURNS OF RING WINDING MAY BE ARRANGED IN PARALLEL INSTEAD OF IN SERIES

Many so-called standard dynamometer wattmeters of the straight-through type designed for currents exceeding 100 amp. are unsatisfactory except for use on circuits of approximately unity power factor. The defects are mainly due to eddy currents and skin effect. Eddy currents in the metal forming the main conductors, and in any other metal work used in the construction of the instruments, cause the active part of the flux in the main-current coil to be out of phase with the main current, while the skin effect may cause variations in the distribution of the current over the cross-section of the main conductors with changes in frequency, and this may consequently affect both the magnitude and the phase of the active part of the main-coil flux. The active conductors of the pressure coil cannot be made to embrace more than a small portion of the main-coil flux, and for successful working this portion must always be a definite fraction of, and in the same phase as, the whole flux. It is not very difficult to eliminate eddy currents by avoiding the use of metal supports, etc., and having the main coils formed of stranded conductors, each strand being insulated; but in order that the current distribution may be maintained constant independently of changes in the frequency of the current, it is necessary that every strand of the conductor have the same time constant (LR). There are many difficulties in the way of the satisfactory stranding of the conductor, if it is intended for currents of upward of 1000 amp.

In the wattmeter described by the author use has been made of the concentric magnetic field which is formed between two concentric conductors when a current is maintained in them in opposite directions.

If a wire be wound uniformly over the surface of a ring as shown in Fig. 1, the magnetic field produced when a current is maintained in the wire is symmetrical about the principal axis of the ring, so that every turn of the wire incloses the same magnetic flux and, presumably, has the same ohmic resistance and therefore the same time constant. If all the turns are cut and their ends securely connected to copper end plates (Fig. 2), the turns will be connected in parallel instead of in series, and the time constant of any one turn will still remain the same as that of every other turn, since each will be of the same resistance and will embrace the same flux. Therefore, if an alternating current be maintained in the coil thus formed it will be uniformly distributed over the turns, and the uniform distribution of the current will be unaffected by changes in the frequency. The winding must be perfectly symmetrical.

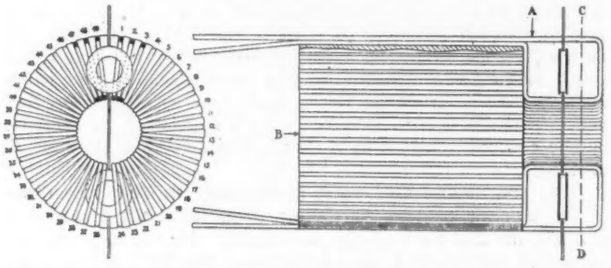


FIG. 3—CURRENT ELEMENT OF CONCENTRIC WATTMETER, MADE UP OF FORMED COILS "A", MOUNTED ON SLOTTED WOODEN CYLINDER "B"

Fig. 3 illustrates how the pressure coils may be arranged within the current coil. Two coils are used in order to render the system astatic to uniform stray magnetic fields. The magnetic axes of the pressure coils are nominally perpendicular to the direction of the flux produced in the main coil, and the result is a turning moment about a vertical axis.

Generators, Motors and Transformers

Duration of Starting Period of Continuous-Current and Induction Motors.—J. SAINT-GERMAIN.—The author, in continuation of an article previously published by him, gives two methods, one graphical and one algebraic, to calculate the duration of the starting period of continuous-current motors and of induction

motors furnished with starting rheostats. The methods described are then applied to particular cases.—*Revue Gén. de l'Elec.*, July 7, 1917.

Lamps and Lighting

Data Concerning Incandescent Lamps in France.—A. BOUTARIC.—Conclusion of a series of articles. In this installment the author classifies incandescent lamps according to length of life and conditions of performance. Investigation of 1234 lamps in twenty-six different establishments showed the great progress made in metallic-filament lamps, to which the author accords the superiority. In 1908 the lamps burning 200 hours were 67 per cent of the total number, those burning 400 hours were 50 per cent, those burning 600 hours were 41 per cent, those burning 800 hours were 37 per cent, and those burning 1000 hours were 31.5 per cent. In 1914 these percentages had risen to 98, 96, 94, 87 and 80 per cent respectively. There was a marked increase in durability after the employment of the pressed filament. Under the heading "Conditions of Performance," the author considers the influence of variations of voltage upon the luminous intensity and energy expended, the relation between voltage and energy expended, the influence of the voltage on specific consumption, the reduction of luminous surface sources for intensive lighting, the performance of lamps under alternating current, the repartition of light, the economic performance of incandescent lamps, and their employment for public lighting. Before the war French factories produced 30,000,000 metallic-filament lamps a year, in addition to those of carbon, and the author looks for an augmentation of this production with the return of peace.—*Revue Gén. de l'Elec.*, June 23, 1917.

Traction

Recuperative Electric Railway from Gergal to Santa Fé, Spain.—LUCIEN PAHIN.—Electric traction with provision for the recuperation of energy is susceptible of producing interesting economic results upon mountain lines if the grade of the road lends itself to the system. The cost fuel at the power house is much reduced, the greater part of the energy necessary for traction on the ascents being furnished by the trains which are descending at the same moment. This system is in force in the 22-km. (13.6-mile) line from Gergal to Santa Fé in the south of Spain, an important mining region, and, the author says, has been found, after six years' trial, much more advantageous from a triple point of view—technical, commercial and financial—than steam locomotives. The latter have, however, been retained for the passenger service, which is not important. The loaded mineral trains on the descent from Gergal weigh 450 metric tons (495 tons), while the empty trains ascending from Santa Fé weigh one-third this amount. The electric energy is three-phase at 6000 volts and 25 cycles and is generated by an alternator directly connected to a Lentz cross-compound engine; but so economical is the system that the power house is called on to take care of little besides the starting period.—*Revue Gén. de l'Elec.*, July 7, 1917.

Installations, Systems and Appliances

An Experimental Investigation of a New System for Automatically Regulating the Voltage of an Alternating-Current Circuit.—JOHN ALAN TERRELL.—The author has experimentally investigated a new method of automatically controlling the voltage of alternating-current circuits so as to cause the voltage to increase as the load on the apparatus increases, to determine the actions which go on in the apparatus, and to ascertain the commercial value of the invention. The apparatus which the purpose of this thesis was to investigate requires no moving parts, the action being due to change in the electrical and magnetic conditions brought about by changes in load.—*Rensselaer Polytechnic Institute Engineering and Science Series*, No. 9.

Electrophysics and Magnetism

Instability of Electrified Liquid Surfaces.—JOHN ZELENY.—The author in a recent paper gave a brief description of the appearance of a liquid surface undergoing disintegration owing to instability arising from an electric charge. The observations recorded were made in connection with some experiments on the electric discharge from liquid surfaces, and the work was confined to eye observations, through a microscope, of the surface in question when this was illuminated by the light of a spark from a Leyden jar. Some of the phenomena appeared to be of sufficient interest to warrant the making of a more accurate record of them by the aid of photography, and a few results obtained by this method are described in this paper.—*Physical Review*, July, 1917.

Units, Measurements and Instruments

The Thermophone as a Precision Source of Sound.—H. D. ARNOLD and I. B. CRANDALL.—The writers have found that the thermophone, together with a suitable supply of alternating current, can be used very conveniently as a precision source of sound energy. On account of the fact that the published material on this electrical-acoustic effect is largely of a qualitative character, it has been necessary to work out a quantitative theory, and it is the purpose of this paper to give the theory and show how the instrument can be adapted to acoustic measurements.—*Physical Review*, July, 1917.

Effusion Method of Determining Gas Density.—J. D. EDWARDS.—The effusion method of determining gas density, which is based upon the fact that the times required for the escape of equal volumes of two gases under the same pressure through the same small orifice are approximately proportioned to the square roots of the densities of the gases, was investigated in order to determine the accuracy of the method and its sources of error. In co-operation with a number of men employing this method in the natural-gas industry, a series of experiments was made, using their apparatus under field conditions. It was found that results in error by more than 10 per cent were not unusual. The theory of the effusion process was investigated in order to determine the influence of the numerous variables affecting the apparent specific gravity. The relative rates of effusion of air as compared with hydrogen, argon, methane and carbon dioxide at different pressures and with different orifices were determined. A more detailed treatment of the theory in the light of these results will be given in another paper. The results obtained from this study, together with the observations made on the effect of the effusion pressure, the confining medium and the shape and size of the orifice, were used in determining the most favorable conditions

of operation for this method. Recommendations are made as to the most suitable type and form of apparatus for use and specifications given to guide in the construction of the orifice. Although no results of high accuracy can be expected from apparatus of the effusion type, yet it should serve well for approximate results or for work where relative values only are needed, as in control work. It has been shown that the apparent specific gravity as determined by this method can be varied within rather wide limits by changing the conditions. However, by the observance of certain precautions in the construction and use of the apparatus it is possible to secure results accurate to about 2 per cent. The greatest precision is obtained where the physical properties of the gas tested show the least difference from those of air. Some further increase in accuracy, and particularly in reliability, can be gained by standardizing the apparatus as recommended. —*Technologic Paper No.* 94, Bureau of Standards.

Telegraphy, Telephony and Signals

Laws of Inductive Interference.—A. H. FORD.—Inductive interference is a matter of increased importance in Iowa, for some 750 miles (1207 km.) of high-tension lines were built in the last year. The grounded telephone line is in extensive use in this State, so that special consideration is given it in this paper. Electrostatic induction as regards grounded telephone lines is first taken up. Transposition can never entirely overcome interference due to static induction, the author points out, but it serves to reduce it to a negligible amount if the distances between transposition sections are so short that the impedance of the wire in one of these sections is small in comparison with the impedance of the telephone. The customary distance between transposition points in open wire lines is from one-quarter of a mile to 2 miles (0.4 km. to 3.2 km.) Another way to reduce the static induction on a metallic circuit is to place the two wires of the circuit close together. This distance is customarily 10 in. (25.4 cm.) in open-wire lines, as a smaller separation allows the wires to swing together. The wires may have the distance between them reduced to a very small amount where cables are used. The use of cables made up of twisted pairs reduces the interference to an entirely negligible amount. The neutralization of static induction by means of transposition requires that the telephone circuit be perfectly insulated, for the potential between a single wire and the ground is the same for a metallic circuit as for a grounded circuit. The grounding of one wire will therefore reduce a metallic circuit to the equivalent of a grounded one, so far as electrostatic induction is concerned. Interference from static induction, due to insulated power lines, can be reduced by making the telephone line metallic and transposing the telephone wires just as in the case of a grounded power line. Care must be taken in planning the transpositions that the transposition points of the two systems are co-ordinated. Inductive interference is practically always present when telephone lines and power lines parallel each other for distances of 1 mile (1.6 km.) or more, at separations of 50 ft. (15.2 m.) or less, this being the customary separation of the circuits where both follow the country roads. Where the exposure is between a power line and a metallic circuit telephone line, the power line should be transposed throughout its length so that each wire will have the same capacity to earth as the other wires, there being no transpositions within the limits of the parallel, unless the parallel has a length greater than 6 or 8 miles (9.6 or 12.8 km.). The telephone line should be transposed within the parallel of such points as to cut it up into an even number of sections having equal lengths. —*Telephony*, July 7, 1917.

Book Reviews

REPERTORIUM DER PHYSIK. By Rudolph H. Weber and Richard Gans. Leipzig and Berlin: B. G. Teubner. 614 pages, illustrated.

This is the second section of the first volume of a treatise on physics from a mathematical point of view. This section has been prepared by Profs. R. H. Weber and Paul Hertz. It deals with capillarity, heat, thermodynamics and gas mechanics. The book is thorough and carefully drawn up. It will be of value to the advanced student of physics and physical chemistry who is familiar with the German language. The chapters dealing with the subject of capillarity will be found particularly commendable.

"THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY FOR 1917. London, England: The Electrician Printing & Publishing Company, Ltd. 1382 pages, with a Biographical Section. Price, $4.

Much valuable information is contained in this useful annual, now in its thirty-fifth year. The directory section is in six principal divisions, British, Colonial, Continental, Asiatic and African, Central and South American, and United States. In addition to the lists such subjects as the following are treated broadly: Law relating to electric light, power and traction; fire risk and electric wiring rules, etc. Financial information and biographical sketches of men who have attained prominence in the industry are other features that add to the usefulness of the book.

ELECTRICAL MEASUREMENTS IN PRACTICE. By F. Malcolm Farmer. New York: McGraw-Hill Book Company. 360 pages, 230 illustrations. Price, $4.

This is an excellent and timely text and reference book on electrical measurements from the industrial viewpoint. There are various excellent treatises available on the principles and physical relations of electrical measurements, but there are very few which deal with electrical measurements as they have to be made in electrical engineering laboratories for the purposes of the industry. The book is divided into sixteen chapters dealing with the following subjects: Introductory, galvanometers, continuous emf. measurements, continuous-current measurements, alternating emf. measurements, alternating-current measurements, resistance reactance and impedance measurements, power measurements, energy measurements, maximum-demand instruments, inductance measurements, capacitance measurements, frequency and slip measurements, wave-form determinations, magnetic measurements, curve-drawing instruments. The treatment is clear, thorough, practical and up to date. The chapter on maximum demand instruments is particularly timely.

Higher Boiler Pressures and Temperatures

To the Editor of ELECTRICAL WORLD:

Sir: The feasibility, advisability and desirability of employing higher steam pressures and temperatures follow the natural and important endeavor continually being made to increase the efficiency in using heat. Since it is now quite common practice to obtain and maintain a vacuum within 1 in. (2.54 cm.) of absolute, the simplest—in fact, only—other direction in which more energy may be obtained from the steam is to raise the steam pressure. That doing so is full of promise, which should act as a powerful incentive, was brought out in the April 28, 1917, issue of the ELECTRICAL WORLD. It was only the theoretical gains that were discussed at that time, however.

In discussing higher steam pressures 200 lb. per square inch (14.06 kg. per sq. cm.) may be considered high for small stations, although it is commonly used in the larger ones, whereas 225 lb. per square inch (15.82 kg. per sq. cm.) is being used in some stations, with 350 lb. per square inch (24.61 kg. per sq. cm.) in possibly a few isolated and exceptional instances. It will probably be a long time before pressures in excess of 225 lb. per square inch (15.82 kg. per sq. cm.) will be considered for the small stations, partly from considerations of safety and because of the necessary limitations in personnel and facilities, and partly because operating conditions are rarely such as to permit offsetting the higher cost of apparatus. The smaller stations might find it a more fruitful move to give greater attention to careful and scientific firing, high vacuum, than to higher steam pressures. It is a very different matter with the large stations, however, with their much heavier loads, load factors and better facilities for repair, maintenance and supervision.

Probably the standard pressure may be said to be 200 lb. per square inch (14.06 kg. per sq. cm.) in the majority of stations, at 200 deg. Fahr. (93.3 deg. C) superheat, equivalent to a temperature of 600 deg. Fahr. (315.6 deg. C.). When the pressure is increased above about 350 lb. per square inch (24.61 kg. per sq. cm.) to those proposed from time to time—for example, 600 lb. per square inch (42.18 kg. per sq. cm.), it is then that the practical considerations might be expected to interfere with the theoretical gains. While some of these factors mitigating against increased efficiency in the use of the steam are certainly metallurgical limitations due to the metals or their treatment, some of them are otherwise. Higher pressures require higher strength of structures withstanding them—boiler, pipes and fittings, economizers, turbine parts, etc. —but higher heat losses are also to be expected. While in time doubtless design and the treatment of metal will solve the mechanical problems, a stage must be reached when the greater heat losses and mechanical difficulties will cancel the gain in over-all efficiency.

Readers' Views and Comments

Increase of steam pressure means that there will be a lower temperature drop between the furnace gases and the steam inside the boiler heating surface, which in turn means that the furnace gases will leave the heating surfaces at a higher temperature than where lower pressures are used. If heat is not to be wasted by passing up the stack, additional heating surface—in the form of economizers, usually—must be installed. The economizer is finding increasing application in central stations where load factor is favorable, and possibly will be a necessary adjunct where the high steam pressures are utilized.

As regards greater strains upon metallic parts, boilers, economizers and steam pipes and fittings will, of course, have to be made stronger. This will mean modified design of the boilers, no doubt, and of the economizer to a small extent, above about 350 lb. per square inch (24.61 kg. per sq. cm.), adding to the initial cost. While the steam pipes will require greater care in installation and as regards strength, they may also be smaller for a given output, since the density is higher at the higher pressure and hence the passage of steam is lower. The cost of steam piping may be expected to remain about the same. The welded flange joint, first employed at the Fisk Street station of the Commonwealth Edison Company, and described in the March 18, 1916, issue of the ELECTRICAL WORLD, may be expected to come into greater use in the interests of safety and reliability and lower cost for upkeep.

It is possible the chief problems in utilizing such high pressures as 600 lb. per square inch (42.18 kg. per sq. cm.) will occur in the prime mover—the turbine. Higher pressures will add to the leakage and friction losses of the turbine, of the high-pressure element particularly, tending to lower the efficiency and nullify the gain due to increased pressure. Corrosion and erosion of the turbine blades may be expected likewise to occur to a marked extent, due in part to the entrained moisture in the steam, adding to the cost of maintenance and making the drop in efficiency decrease with time more rapidly. The moisture formed thus, while a disadvantage so far as the turbine blades are concerned, is somewhat equivalent in effect to increased condenser cooling surface. The higher cost for blade maintenance can then be balanced against lower condenser cooling surface and the labor required to keep it in fit condition.

Large companies will be the ones to assist the manufacturer develop apparatus that is safe, reliable and efficient. J. C. RUTHERFORD.

Chicago.

A Common Forum Needed

To the Editor of ELECTRICAL WORLD:

Sir: From time to time I notice editorials in the ELECTRICAL WORLD setting forth the necessity for an organization where the representatives of central stations, manufacturers, jobbers, dealers and contractors can get together and discuss their common problems. In your issue of July 28 you have an editorial upon this subject in which you say, "An organization of this sort cannot be successfully constructed on short notice and there may be obstacles to overcome."

The Society for Electrical Development is such an organization, and the members of the society, through their representatives on the board of directors and upon the executive committee, meet and discuss their common problems. It is possible that more can be done along these lines, and possibly the scope of the society can be enlarged. The point that I have in mind is that there is such an organization, and that the ELECTRICAL WORLD should, it seems to me, advocate enlarging the scope of the existing organization rather than the formation of another one. The feeling exists that there are already enough organizations in the electrical field. Why increase them?

There are no problems common to the interests in the electrical field which cannot be handled by the Society for Electrical Development, whose membership is made up of central stations, manufacturers, jobbers, dealers and contractors. Any member can suggest any problem which he would like to have taken up by the board or the executive committee of the society, and I should appreciate your calling attention to this fact. I am afraid that any one reading your editorial "A Common Forum Needed" would feel that no such organization existed, or that the ELECTRICAL WORLD did not know of it, or else did not appreciate its possibilities.

As your paper is a member of the society and has representation upon its board of directors through James H. McGraw, who constantly sits in its meetings, is interested in its activities and expresses his appreciation of the good work done by the society, I feel that we are entitled to recognition, which we do not get in your editorial. The publication of this letter as a comment upon your editorial would be appreciated. J. M. WAKEMAN,

General Manager Society for Electrical Development, Inc., New York City.

[We are not unmindful of the excellent work of the Society for Electrical Development in popularizing and fostering the use of electricity. Too much cannot be said of its achievements along these lines. However, the forum which the editorial suggests would be wider in scope and would not duplicate or usurp any of the functions of the society. In a previous editorial on the subject (May 26, 1917) reference to the work of the Society for Electrical Development was included.—EDITOR.]

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University

COAL ECONOMY RESEARCH

Necessity of Considering New Ways of Increasing Fuel Production, Burning Substitutes for Coal and Eliminating Losses

The problem of coal economy, important as it is at all times, has assumed unusual proportions of late owing to the war and the tremendous increase in the demand for coal. There is an actual shortage of miners, freight cars, ships, mining machinery and supplies. The gravity of the situation was explained to some representatives of the coal trade by the chairman of the fuel committee of the Council of National Defense as follows: "Italy wants 1,000,000 tons of Pocahontas coal per month for the coming year; France is depending upon this country for industrial and domestic coal; England's South American trade is transferred to us to supply, and Canada is in for 2,500,000 tons of Eastern coal, due to her own miners having been drawn from the Nova Scotia field to be used in the war. Our own transports, troop ships and convoys, together with added merchant ships, will mean additional drain for our own needs. Furthermore, it is not unreasonable to assume that the activity of our own navy will mean a larger consumption of coal."

Another thing made clear by the fuel committee was that the Northwest lake trade must be supplied at all hazards with every available pound of coal, even to the exclusion of all other home markets. This Great Lakes trade is considered a very serious matter because 60,000,000 tons of iron ore must be transported to the various manufacturing centers while navigation is open.

While various private and governmental agencies are attacking the problem vigorously and are taking administrative measures to alleviate the immediate dangers of the situation, the great fundamental problem of more economical production of heat remains for engineering experts and scientific investigators to solve. Among the various research problems in this connection the following suggest themselves as being the most important ones for electric power supply and consumption:

Mining by machinery to reduce manual labor and to increase production; electricity has a wide field of applications here, in undercutting coal, drilling holes, exploding charges, moving cars, loading, hauling, crushing, screening, telephone communication, lighting, mine ventilation, pumping, etc.

Utilization of thin seams, which are unprofitable to be mined by hand labor, but which may be mined by scrapers, conveyors and other similar machinery.

Better combustion of coal in industrial boilers and in domestic furnaces.

The reason for which certain coals (for example Illinois coals) do not burn well unless abundantly wetted with water, with a resultant loss of heat. Arrangements that would enable such coals to be burned well dry.

Utilization of lower grades of coal, peat, lignite, etc.

Burning coke and gas in place of raw coal; a combination of by-product ovens with a boiler plant, to avoid handling and drenching coke with cold water after its production.

Use of pulverized coal, the problem of briquetting, etc.

Indicators and automatic regulators for maintaining the best combustion in a boiler with varying load.

Conversion of coal into electricity at the mines, with a minimum of handling and storage of coal, and also for the purpose of making electric power supply independent of railway transportation of coal.

Reduction in steam losses between the boilers and the prime movers.

More economical prime movers and plant auxiliaries.

Scientific lighting and higher efficiency illuminants to reduce waste of electricity.

More economical use of electric power in industries.

Reduction in power consumption by electric railways.

Introduction of efficient electric power in places where now wasteful small steam plants are used.

In conclusion the two familiar old-new problems for the inventor may be mentioned, namely, (a) the gas turbine, and (b) direct production of electricity from coal (thermo-electricity) without first converting heat into mechanical power.

Summary of Investigations, Available Apparatus and Research Suggestions

INVESTIGATIONS UNDER WAY OR COMPLETED (RESEARCH WORK REPORTED SINCE JULY 21)*

CORONA.

A study of the corona at continuous potentials. A large number of direct-current generators are available which may be operated in series and which make it possible to obtain potentials up to 25,000 volts with current capacity of 0.5 amp.—*E. B. Paine, University of Illinois.*

IGNITION APPARATUS.

The characteristics of electric ignition apparatus for gasoline engines.—*E. B. Paine, University of Illinois.*

INSULATORS.

Experiments on a large scale to determine the effects of porosity in porcelain.—*H. J. Ryan, Stanford University, California.*

INTERFERENCE.

In the last few years a great deal of work has been done to protect telephone systems which parallel high-voltage transmission lines. As the system now used has practically stopped all telephone instrument trouble, the measures adopted are evidently complete.—*E. P. Peck, Georgia Railway & Power Company, Atlanta, Ga.*

IRON AND ALLOYS.

An investigation of the effect of alloying substances on the magnetic and other properties of iron. Continuous work has been done in the department for several years. The properties of electrolytic iron of great purity have been determined, and also the influence of various percentages of boron, silicon, aluminum and nickel. Samples of iron having magnetic permeability far surpassing that reported by other investigators have been produced. Permeabilities of 50,000 or more have been found in testing certain of the high-permeability alloys. In the nickel-iron series some alloys have been found whose permeability varies greatly with the temperature of the specimen, the permeability ranging in some cases from about 700 at room temperature to a value of two or three at the temperature of boiling water.—*E. B. Paine, University of Illinois.*

LIGHTNING PROTECTION.

A large number of 11,000-volt and 22,000-volt outdoor meters have been used by this company. This equipment consists of one tank containing current and potential transformers in oil, with the meter in a separate compartment. Some trouble was experienced at first with this apparatus, owing to the current transformers and transformer leads becoming short-circuited by lightning and line surges. This trouble has been greatly reduced, however, by the connection of a vacuum-tube spark gap across the two terminals to each current transformer, the connection being made at the top of the bushing.—*E. P. Peck, Georgia Railway & Power Company, Atlanta, Ga.*

MAGNETIC TESTS.

Influence of joints in ferric magnetic circuits. The distribution of magnetic flux in high-permeability iron and its effect upon the magnetic properties. The influence of mechanical stress on the magnetic properties of iron. This investigation was suggested by difficulties encountered in testing high-permeability iron on account of variations in the tightness with which joints were clamped together in making tests.—*E. B. Paine, University of Illinois.*

PUMPS.

A study of electrically operated reciprocating deep-well pumps. —*E. B. Paine, University of Illinois.*

SUGGESTION FOR RESEARCH

FUSES.

High-voltage fuses for use on the line side of customers' stations, for voltages from 11,000 to 45,000 and for transformer capacities of from 25 kva. to 45,000 kva. Such fuses have not been sufficiently developed.—*E. P. Peck, Georgia Railway & Power Company, Atlanta, Ga.*

*The names of individuals given after each institution reporting investigations are those of persons with whom others interested should communicate. All institutions reporting research work should give such names.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

INSULL INTERESTS BUY WISCONSIN PROPERTIES

Controlling Share in Wisconsin Power, Heat & Light Company Is Purchased from John I. Beggs

A controlling interest in the Wisconsin Power, Heat & Light Company, which was formerly held by John I. Beggs of Milwaukee, has been purchased by Samuel Insull and Marshall E. Sampsell of Chicago and a group of other utility men identified with the associated Insull companies.

The property of the Wisconsin Power, Heat & Light Company consists of several small generating stations and of distribution systems in twenty-seven Wisconsin cities and towns, among which are Beaver Dam, Berlin, Baraboo, Burnett, Fox Lake, Horicon, Juneau, Lohrville, Neshkora, Minnesota Junction, Red Granite, South Beaver Dam, Portage and Wautoma. A portion of the energy is generated locally, and the remainder is purchased from the Southern Wisconsin Power Company, which has a hydroelectric plant at Kilburn.

Mr. Beggs, who is president, treasurer and general manager of the Southern Wisconsin Power Company, will remain director of the Wisconsin Power, Heat & Light Company. Samuel Insull is chairman of the new board of directors.

While definite plans have not been announced, it is understood that the Wisconsin company will become a part of the Middle West Utilities Company.

ELECTRIC WORK ON THE LOUISVILLE CANTONMENT

Installation by Louisville Gas & Electric Company While Contractors Pool Forces for Interior Construction—Quantities of Materials

Work of installation of the electric lighting system at the new National Army cantonment just outside of Louisville is now well under way. The outside lighting is being provided for according to the plan of the army engineers, installation being made on a cost and material basis by the force of the Louisville Gas & Electric Company, while the Louisville electrical contractors have pooled their forces to install the interior lighting systems in the numerous buildings.

A detailed description of this work is not available at the Louisville cantonment at this time, but it is of interest to note the approximate quantity of materials used. For the interior wiring, which will be of open construction, a total of approximately 20,000 sockets are to be used. The transmission wire which has been erected to the camp will deliver energy at the usual transmission voltage of 13,200. There will be three 400-kw. step-down transformers erected on steel towers for step-down substations, which will reduce the voltage to 2300 volts, three-phase, 60-cycle. Elsewhere about the plant will be established ninety transformers ranging from 1 kw. to 20 kw.

A total of about 1100 cedar poles will be required, 30 ft. and 35 ft. (9 m. and 10.5 m.) in height. There will be 320 lamps, of 6.6 amp., 100 cp., installed in series. About 20,000 ft. (6096 m.) of Nos. 1, 0, 2 and 6 wire will be required, as well as 125,000 ft. (38,100 m.) of No. 10 copper-clad service wire.

Practically all of the time up to Sept. 1, before or on which date the cantonment is to be ready for occupancy, will be required to complete the construction work. About every available unit of labor in the vicinity is now employed at the camp, and very nearly all incoming applicants are given a chance to show what they can do.

ELECTRIC SERVICE AT THE WRIGHTSTOWN CANTONMENT

Public Service Electric Company of New Jersey Will Supply 900 Kw. for Lighting and Power at New Camp

The Public Service Electric Company, Newark, N. J., will supply the army cantonment at Wrightstown, N. J., with 900 kw. for lighting and power purposes, of which 600 kw. will be for lighting and the rest for power.

For this purpose it is necessary for the company to extend a transmission line about 12 miles (19.3 km.) from its power plant at Burlington to Mount Holly, using poles now in service, and to build an entirely new line for an additional distance of about 8 miles (12.8 km.) to a substation to be erected at the cantonment. This work is now under way and it is hoped to have it completed early in the coming month.

The company will not handle the distribution system at the cantonment, that being in charge of the army engineers.

RIGHT OF EMINENT DOMAIN GRANTED FOR ARMY SERVICE

New England Power Company Secures Transmission-Line Rights from Commission for Cantonment Service at Ayer, Mass.

The New England Power Company has been granted authority to build a transmission line from Leominster to Ayer, Mass., to supply 1500 kw. to the United States cantonment, Camp Devens, at the latter point. Permission to take land by right of eminent domain is granted by the Massachusetts Gas and Electric Light Commission, which finds that public convenience and necessity demand the construction of the line. The order points out that more than 35,000 troops will be supplied with electrical service at the cantonment.

RAISE CAPITAL FUNDS BY SHORT-TIME NOTES

Many Companies Resort to Securities of Early Maturity at High Net Cost to Provide for Capital Extensions

A number of central station companies have taken advantage of present conditions in the security markets to obtain funds for capital investment through the issue of short-time notes. The conditions governing the investment markets at this time are especially favorable to this form of financing. While financing by means of short-maturity notes is as a rule more expensive than the raising of capital by long-time securities, it is recommended by many bankers now.

SOME OF THE COMPANIES ISSUING SHORT-TIME NOTES

Recent issues of such securities are:

Consolidated Gas, Electric Light & Power Company, Baltimore.—An issue of $5,000,000 of five-year 6 per cent notes, dated Aug. 1, 1917, of the Consolidated Power Company, a subsidiary, was sold at 97½ by Alex. Brown & Sons, Brown Brothers & Company, Jackson & Curtis and Lee, Higginson & Company.

Columbus (Ohio) Railway, Power & Light Company.—Sold $576,000 of 6 per cent one-year notes, dated Aug. 1, 1917.

Reading Transit & Light Company.—An issue of $2,300,000 of two-year 6 per cent notes, dated Aug. 1, 1917, was sold at 98½ by Bonbright & Company, Inc.

El Paso (Tex.) Electric Company.—Stone & Webster offered at 97½ $300,000 of three-year 6 per cent notes, dated Aug. 1, 1917.

Texas Power & Light Company.—Issued, through Coffin & Burr, $900,000 of two-year 6 per cent notes, dated Sept. 1, 1917, at 98⅝.

Middle West Utilities Company.—An issue of $1,000,000 of three-year 6 per cent collateral 6 per cent notes, dated July 1, 1917, was offered at 97¾ by the Illinois Trust and Savings Bank; Russell, Brewster & Company; McCoy & Company; Halsey, Stuart & Company of Chicago, and A. H. Bickmore & Company of New York.

Buffalo General Electric Company.—Stockholders were offered the opportunity to subscribe to $4,400,000 of five-year 6 per cent bonds, dated Aug. 1, 1917, and convertible after two years into common stock at par. The issue was underwritten by Lee, Higginson & Company.

Utah Power & Light Company.—A block of $1,000,000 of two-year 6 per cent notes, dated Aug. 1, 1917, has been sold at 98¾ by Harris, Forbes & Company, the Harris Trust and Savings Bank, and Coffin & Burr.

West Virginia Traction & Electric Company.—There has been sold at 98½ by Bonbright & Company, Inc., $1,800,000 of two-year 6 per cent notes, dated May 1, 1917.

West Penn Power Company.—Halsey, Stuart & Company, A. B. Leach & Company, and the Continental and Commercial Trust and Savings Bank, Chicago, have sold at 98¾ $2,000,000 of two-year 6 per cent bonds, dated Aug. 1, 1917.

Alabama Power Company.—Issued, through Harris, Forbes & Company, the Harris Trust and Savings Bank and Coffin & Burr, at 99½, $1,900,000 of five-year 6 per cent notes, dated July 1, 1917.

Philadelphia Electric Company.—Through Brown Brothers & Company, $2,500,000 of one-year 5 per cent notes, dated Aug. 1, 1917, were sold at 99⅛.

Toledo Traction, Light & Power Company.—An additional block of $486,000 of 6 per cent five-year bonds of 1913 has been sold at 100 by Harris, Forbes & Company and the Harris Trust and Savings Bank.

New Bedford Gas & Edison Light Company.—An issue of $1,500,000 of five-year 6 per cent debentures, dated June 1, 1917, has been sold at 100 by Harris, Forbes & Company, the Harris Trust and Savings Bank, Coffin & Burr and Curtis & Sanger.

Lockport Light, Heat & Power Company.—Issued, through John Nickerson, Jr., $350,000 of one-year 6 per cent notes, dated July 16, 1917, at 99½.

Southern California Edison Company.—Issued, through Harris, Forbes & Company, the Harris Trust and Savings Bank, E. H. Rollins & Sons and Curtis & Sanger, at 98⅝, $10,000,000 of two-year 6 per cent bonds, dated July 1, 1917.

This list does not comprise all of the companies in the electrical industry which have done financing within a short period. The General Electric Company, of course, issued $15,000,000 of three-year 6 per cent notes. In addition to the central stations mentioned in the foregoing list, a number of companies have put out additional blocks of bonds under existing mortgages or have sold additional capital stock to their shareholders. Such companies have been fortunate in financing capital requirements by these means under the uncertain influences affecting the investment markets. By placing bonds through bankers with permanent investment holders or stock with their own shareholders they reduce the underwriting costs on these particular capital requirements to the minimum. The companies which sell short-time securities will have to pay another banking commission when those securities mature in order to raise funds for the purpose of redeeming them.

The question of what form of financing shall be adopted during the critical conditions of 1917 is, however, largely beyond control of central station operators. They are obliged to rely upon the judgment of the bankers, who are guided by the temper of their own particular investment clientele. If their following among investors will buy short-time notes readily, but is disinclined to place funds in long-time securities at this juncture, the bankers make their recommendations to the borrowers accordingly.

Naturally securities, to meet quick sale now, have to present special attractions to borrowers. Obligations of the national government, issued and to be issued, have the first call because of patriotic motives and the premier character of the security which they offer. But with the Liberty Loan well placed and details of the subsequent issue still unsettled there is an excellent opening for corporate financing which the central station companies have prudently taken.

HIGH COST OF MONEY UNDER PRESENT-DAY CONDITIONS

Net cost of funds raised by short-time notes put out under prevailing conditions is high. When this high cost is considered in relation to the proportionately higher cost of the improvements which the funds finance it will be seen that the transaction implies a burden upon the companies much greater than that which is represented by borrowing cost and construction cost at normal levels. But, since companies cannot forecast either money cost or material cost in the future, they gain a large advantage by putting out securities when the bankers say that the moment is ripe, even though the net interest expense is greater than usual.

In the foregoing list the prices mentioned are those at which the securities were sold to the public. From the proceeds yielded at these prices there must be deducted the commissions or underwriting expenses of the bankers and the legal and other costs incident to the preparation and issue of the securities.

The unprecedented demands for power, stimulated still more by war activities, make it necessary for many of the companies to raise capital funds even though the cost of so doing is heavy.

SITE FOR NEW TURBINE PLANT AT HARTFORD, CONN.

High-Powered Station Will Be Erected When Present Development at Dutch Point Reaches Its Limit

The Hartford (Conn.) Electric Light Company has purchased a site covering about ninety-five acres in the South Meadows district which will be held in anticipation of the construction at some future time of a large central station. Samuel Ferguson, vice-president of the company, states that the plant will not be erected until the present development at Dutch Point reaches its limit, and that no immediate construction is contemplated. The company has been growing rapidly, however, and it appears to be only a question of time when a high-powered modern station complete in every engineering detail and designed for systematic extension along the latest lines of practice will be necessary. The newly purchased site borders on the Connecticut River.

HUMAN ENGINEERING IN UTILITY CORPORATIONS

Professors of Electrical Engineering Speak to Department Heads of Commonwealth Company on Practical Education of Graduates

On Aug. 9 the five university professors who are spending a large part of their summer vacation in the employ of the Commonwealth Edison Company, Chicago, were entertained at a dinner given by the Central Station Institute. Practically all department heads of the Commonwealth Edison Company and its associated companies were present. About 125 attended the dinner. Fred R. Jenkins, manager of the Central Station Institute, which is the educational department of the Commonwealth Edison Company, acted as toastmaster.

Prof. V. Karapetoff of Cornell University, the first speaker of the evening, sounded the keynote of the educational talks, urging the necessity of continual education for all the employees of any industrial concern. "Where education and development stop," said he, "decay sets in. Mental education is only a small part of the total development of an individual. The complete education comprises that of the body, the intellect, the will and the emotions. At present the intellect only is being developed, with some attention being paid to physical training. But the time is coming when proper education will comprise such things as the will to do things and the proper emotions, such as love of one's neighbor and loyalty to one's employer. These will be the required parts of one's education." Professor Karapetoff also made a plea for human engineering which ought to do for human beings what various physical, chemical and heat treatments do for metals in improving their quality. "It is the duty of every head of a department," he said, "to realize the importance of training for his subordinates. The technique of education, however, has advanced to such a point that a separate department is necessary, conducted by men skilled in the art of inspiring and developing personality."

The other speakers of the evening were Prof. C. Francis Harding of Purdue University, Prof. Murray C. Beebe of the University of Wisconsin, Prof. Ellory B. Paine of the University of Illinois, Prof. Hugo Kuechenmiester of the School of Commerce, University of Wisconsin, and W. L. Abbott, chief operating engineer of the Commonwealth Edison Company.

NEW JERSEY COMMISSION DENIES RATE INCREASE

In Bridgeton Case, Board Shows that Many Companies Have Applied Higher Schedules to Large Power Customers Only

An application of the Bridgeton Electric Company and the Electric Company of New Jersey for authority to increase rates has been denied by the New Jersey Board of Public Utility Commissioners on the ground that such an advance would be unjust and discriminatory toward the small consumer who pays the base rate.

It was proposed by the companies to ascertain at the end of each calendar month the average cost of coal delivered at the power houses and to add to consumers' bills 1 per cent of the amount for each 10 cents per ton of cost in excess of $3.50 f.o.b. Bridgeton, the average prevailing price prior to June 30, 1916; or to deduct 1 per cent for each 10 cents below $3.50.

Testimony showed that in the early months of 1917 coal delivered in Bridgeton cost approximately $7.25 per ton. The increase proposed by the companies, the commission found, did not appear to be warranted by the operating expense data submitted by the companies. The decision says:

> Where energy is sold at very low rates, as is the case with the energy furnished the street railway and large power customers, the proportionate increase in cost due to increased cost of coal is higher. It is due to this fact that many companies in adopting a schedule which will take into account increases in fuel cost have applied such schedules to the large power customers only. The additional cost of service due to increases in coal cost are not proportional to the rate charged, but are proportional to the fuel portion of the cost.

TESTS ON LIFE OF RUBBER INSULATING COMPOUNDS

Underwriters' Laboratories' Investigation in Connection with Work on Rubber-Covered Wires and Cables Yields Valuable Data

In connection with its work on rubber-covered wires and cables, the Underwriters' Laboratories, Inc., has in progress a series of tests bearing on the life of the rubber insulating compounds employed on these materials. This work has been conducted along with and supplementary to the regular work of inspection and labeling of these products carried on in co-operation with manufacturers throughout the United States on rubber-covered wires and cables manufactured in accordance with Underwriters' Laboratories' standards for rubber-covered wires and cables as prescribed and summarized in the National Electrical Code. These tests have now been in progress about two years, and during this time tests have been conducted on over 1500 samples. The tests have yielded data of value.

The samples of rubber-covered wire subjected to the tests included products of thirty-three manufacturers employing the label service of the Laboratories. All samples were from product manufactured as "National Electrical Code standard," in accordance with the Underwriters' Laboratories' standards.

MEETING OF ASSOCIATION OF EDISON LIGHTING COMPANIES

Officers Will Be Elected and Necessary Business Will Be Transacted, but No Printed Reports Will Be Presented

Arrangements have been made to hold the annual meeting of the Association of Edison Illuminating Companies at 29 West Thirty-ninth Street, New York, Sept. 11, 1917. Owing to unusual conditions caused by the existing state of war, the reports of committees were not printed this year and will not be presented for discussion at the September meeting. It has also been thought advisable to abandon the customary entertainment program. The meeting this year will be devoted solely to the transaction of necessary routine business, in accordance with the association's bylaws, and to the discussion of such other matters as may demand immediate attention. Unless otherwise requested, no special arrangements will be made for transportation or hotel accommodations, as it has been assumed that the holding of the meeting in New York and the absence of entertainment features this year will naturally tend to limit the attendance to member company representatives.

"TRADING WITH THE ENEMY" CLAUSES AFFECTING PATENTS

Provisions in the Act Now Before the Committee on Commerce of the United States Senate

As reported in the ELECTRICAL WORLD of July 21, 1917, page 128, the "trading with the enemy" act, which has been referred to the committee on commerce of the United States Senate, contains a number of clauses relating to patents. These are as follows:

(a) An enemy or ally of enemy may file and prosecute in the United States an application for letters patent, or for registration of trade-mark, print, label or copyright, and may pay any fees therefor in accordance with and as required by the provisions of existing law. Any such enemy or ally of enemy who is unable during war or within six months thereafter, on account of conditions arising out of war, to file any such application, or to pay any official fee, or to take any action required by law within the prescribed period, may be granted an extension of nine months beyond the expiration of said period, provided the nation of which the said applicant is a citizen, subject or corporation shall extend substantially similar privileges to citizens and corporations of the United States.

(b) Any citizen of the United States, or any corporation organized within the United States, may pay to an enemy or ally of enemy any tax, annuity or fee which may be required by the laws of such enemy or ally of enemy nation in relation to patents and trade-marks, prints, labels and copyrights; and any such citizen or corporation may file and prosecute an application for letters patent or for registration of trade-mark, print, label or copyright in the country of an enemy or of an ally of enemy after first submitting such application to the Secretary of Commerce and receiving license so to file and prosecute.

(c) Any citizen of the United States, or any corporation organized within the United States, who desires to manufacture or cause to be manufactured a machine, manufacture, composition of matter, or design, or to carry on or cause to be carried on a process under any patent or copyrighted matter owned or controlled by an enemy or ally of enemy at any time during the existence of a state of war, may apply to the Federal Trade Commission for a license; and said commission is hereby authorized to grant such a license, non-exclusive or exclusive as it shall deem best, provided it shall be of the opinion that such grant is for the public welfare, and that the applicant is able and intends in good faith to manufacture or cause to be manufactured the machine, manufacture, composition of matter, or design, to carry on or cause to be carried on the process or to use the copyrighted matter. The Federal Trade Commission may prescribe the conditions of this license and the rules and regulations under which it may be granted and the fee which shall be charged therefor, not exceding $100, and not exceding 1 per centum of the fund deposited as hereinafter provided.

(d) The licensee shall file with the Federal Trade Commission a full statement of the extent of the use and enjoyment of the license, in such form and at such stated periods (at least annually) as the commission may prescribe; and the licensee shall pay at such times as may be required to the alien property custodian (or to such other officer as the President shall direct) not to exceed 5 per centum of the gross sums received by the licensee from the sale of said inventions or use of the copyrighted matter, or, if such commission shall so order, 5 per centum of the value of the use of such inventions or copyrighted matter to the licensee as established by the Federal Trade Commission; and sums so paid shall be deposited by said alien property custodian (or by such other officer as the President shall direct) forthwith in the Treasury of the United States as a trust fund for the said licensee and for the owner of the said patent or copyright registration as hereinafter provided, to be paid from the Treasury upon order of the court, as provided in subdivision (f) of this section, or upon the direction of the alien property custodian or such other officer as the President shall direct.

(e) Unless surrendered or terminated as provided in this act, any license granted hereunder shall continue during the term fixed in the license, or in the absence of any such limitation during the term of the patent or copyright registration under which it is granted. Upon violation by the licensee of any of the provisions of this act or of the conditions of the license, the Federal Trade Commission may, after due notice and hearing, cancel any license granted by it.

(f)The owner of any patent or copyright under which a license is granted hereunder may, after the end of the war and until the expiration of the year thereafter, file a bill in equity against the licensee in the District Court of the United States for the district in which the said licensee resides, or, if a corporation, in which it has its principal place of business (to which suit the Treasurer of the United States shall be made a party), for recovery from the said licensee for all use and enjoyment of the said patented invention or copyrighted matter; provided, however, that whenever suit is brought as above notice shall be filed with the alien property custodian (or with such other officer as the President shall direct) within thirty days after date of entry of suit; provided, further, that the licensee may make any and all defenses which would be available were no license granted. The court on due proceedings had may adjudge and decree to the said owner payment of a reasonable royalty. The amount of said judgment and decree, when final, shall be paid on order of the court to the owner of the patent from the fund deposited by the licensee, so far as such deposit will satisfy said judgment and decree; and the said payment shall be in full or partial satisfaction of said judgment and decree, as the fact may appear; and if after payment of all such judgments and decrees there shall remain any balance of said deposit, such balance shall be repaid to the licensee on order of the alien property custodian (or such other officer as the President shall direct). If no suit is brought within one year after the end of the war, or no notice is filed as above required, then the licensee shall not be liable to make any further deposits, and all funds deposited by him shall be repaid to him on order of the alien property custodian (or such other officer as the President shall direct). Upon entry of suit and notice filed as above required, or upon repayment of funds as above provided, the liability of the licensee to make further reports to the Federal Trade Commission shall cease.

If suit is brought as above provided, the court may at any time terminate the license, and may, in such event, issue an injunction to restrain the licensee from infringement there-

after, or the court, in case the licensee prior to suit shall have made investment of capital based on possession of the license, may continue the license for such period and upon such terms and with such royalties as it shall find to be just and reasonable.

(g) Any enemy or ally of enemy may institute and prosecute suits in equity against any person other than a licensee under this act to enjoin infringement of letters patent and copyrights in the United States owned or controlled by said enemy or ally of enemy, in the same manner and to the extent that he would be entitled so to do if the United States were not at war.

(h) Except as provided in this section, nothing in this act shall be construed to authorize the prosecution or maintenance of any suit or action at law or in equity by an enemy or ally of enemy in any court within the United States prior to the end of the war; provided, however, that an enemy or ally of enemy may defend by counsel any suit in equity or action at law which may be brought against him. All powers of attorney heretofore or hereafter granted by an enemy or ally of enemy to any person within the United States, in so far as they may be requisite to the performance of acts authorized in subsections (a) and (g) of this section, shall be valid.

ENGINEERING COUNCIL NAMES ITS STANDING COMMITTEES

Body Which Was Organized in June Is Now Engaged in Active Work on Matters of Concern to All Engineers

Calvert Townley, secretary of the Engineering Council, has advised us that that body, which was organized in June, as previously announced in these columns, is now engaged in active work on matters of concern to all professional engineers. Subsequent to the organization meeting held on June 27, the council held two other meetings during July. Its standing committees are:

On Public Affairs—C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice, Jr.

On Rules—J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus.

On Finance—B. B. Thayer, I. E. Moultrop, Calvert Townley and Alexander C. Humphreys.

Many matters coming before the council, both from the several founder societies and from the council's predecessor, the Joint Conference Committee of National Engineering Societies, have been considered and referred to appropriate standing committees.

The council has also created a war inventions committee, comprising H. W. Buck, A. M. Greene, Jr., and E. B. Kirkby, to co-operate with the Naval Advisory Board and other departments at Washington if desired in the promulgation to engineers of war problems now before the government and for which there are opportunities for solution by means of inventions. It also created a committee, comprising George J. Foran, E. B. Sturgis, A. S. McAllister and A. D. Flinn, which is to collect and compile such information regarding engineers of the country as will enable it to co-operate with the different departments of the federal government.

While the council comprises only members from the four founder societies, and, of course, can claim no right to speak for members of other societies nor for engineers at large, the council members feel that the body will not have accomplished the results for which it was created unless it early establishes means of cordial co-operation with engineers, organized or otherwise. Every effort toward this end is contemplated.

ANNUAL MEETING OF THE PENNSYLVANIA ASSOCIATION

Program Will Consist Principally of Addresses by Prominent Men and the General Discussion of the Conditions Brought on by the War

The tenth annual meeting of the Pennsylvania Electric Association (State branch N. E. L. A.) will be held at the Bedford Springs Hotel, Bedford Springs, Pa., Sept. 7 and 8. There will be no papers prepared and no printed reports, the meeting consisting principally of addresses to be delivered by W. D. B. Ainey, chairman of the Pennsylvania Public Service Commission; Joseph B. McCall, president of the Philadelphia Electric Company, and J. W. Lieb, president of the National Electric Light Association. Provision has been made for a general discussion of questions of importance brought about by war conditions and for reports of the standing committees. There will be no entertainment features whatsoever, all of the time allotted to the convention being taken up by serious consideration of problems awaiting solution, the officers feeling that these were important enough to warrant this. George B. Tripp of Harrisburg is president and Henry M. Stine of Harrisburg is secretary of the association.

CONSOLIDATION OF CONNECTICUT PLANTS

Commission Does Not Commit Itself as Approving Purchase Price as Fair Value in Any Future Cases Before It

A controlling interest has been acquired by the United Gas Improvement Company in the Connecticut Light & Power Company, a new corporation formed by consolidation of the Housatonic Power Company, the United Electric Light & Power Company and the Seymour Electric Light Company with the Rocky River Power Company.

In approving the consolidation of properties in connection with the general transaction the Connecticut Public Utilities Commission says:

> The data submitted by the several companies is, of course, available for whatever value it may have in any later matters involving rates or service of the consolidated company, but such data would not be binding upon the commission and the commission would not consider itself bound to give controlling weight to such figures in any case involving the adequacy of the service or the reasonableness of the rates of the consolidated company. In the present case it appears that there is no divergence between the amount stated as the purchase price of the several companies and the book value of their assets which is sufficient to warrant serious objection by the commission.
>
> It is not assumed, however, from any order of approval issued by the commission in this case that the proposed purchase price is found and decreed to be the fair value of the properties of the company for rate making, capitalization or any other purposes than those involved in the question now before us. In any rate case, for instance, that portion of the capitalization of the public service company which represents inactive and undeveloped property must be carefully weighed so far as it can be ascertained, to avoid approval of rates designed to secure a full return on such capitalization.

A map and general outline of the consolidation plans were published in the issue of the ELECTRICAL WORLD for July 21, 1917, page 124.

INDIANA RATE CASES BEFORE THE COMMISSION

Testimony of Indianapolis Light & Heat Company and Merchants' Heat & Light Company Shows Increased Operating Costs

The Indiana Public Service Commission, after hearing the first evidence on petitions of individual electric companies for increased rates because of the tremendously increased costs of operation, took the cases under advisement. The petitions for authority to add surcharges to each regular bill were filed by the Indianapolis Light & Heat Company and the Merchants' Heat & Light Company of Indianapolis. The evidence introduced was of a nature to show conclusively that electric companies face in 1917-18 the hardest winter of their history. The commission probably will give no decision until it has heard the majority of the similar cases which have been filed by many companies.

A great mass of testimony was introduced at the hearings on Aug. 8 to show that high costs of coal, materials, and labor and increased taxes, etc., have increased operating expenses to such an extent that companies must have relief.

A memorandum presented by the Merchants' Heat & Light Company said that on account of the extraordinary increases in operating expenses it finds "that with proper allowance for depreciation—not exceeding 3 per cent—it has a deficit from operations from July 1, 1916, to June 30, 1917, of $154,358, and for the year ending June 30, 1918, its operations, based upon careful estimates, will show a loss of approximately $560,000, basing income upon the present rates for service. The losses resulting from last year's operation cannot now be recouped." The memorandum adds:

> But the commission can grant, upon sufficient showing, such relief as will materially lessen the losses of the company's operation for the next year and make it possible for the company to finance the usual necessary extensions and betterments of its plant to such an extent that its losses may not result in the curtailment of its service or the substantial deterioration of its property.

The memorandum also sets forth that when the present rate schedules were filed coal was 75 cents a ton for screenings and $1.10 for mine run, but to-day coal on the open market is "what the traffic will bear." It was estimated at the hearing that the average cost of coal for the next year will be $3.15 a ton, delivered at the plant.

C. C. Perry, president Indianapolis Light & Heat Company, testified that a great burden had been added to operating expenses because many private electric plants of manufacturing firms and office buildings have been closed. In such cases application has been made to his company for service under present rates. These rates meant much smaller expense to consumers than they would have had in operating private plants under prevailing conditions of coal cost. Mr. Perry pointed out that the more the company added of this class of customers the more it lost, but that it was compelled to give such service wherever asked, under existing rules and schedules.

From questions asked by E. I. Lewis, chairman of the commission, the possibility was suggested that if the right to make a surcharge should be granted to companies, such a surcharge might be made to fall more heavily on manufacturing consumers than on residence consumers.

Mr. Lewis questioned Mr. Perry extensively on the relative percentage of power and light business. Both of the Indianapolis companies were asked by the commission to submit data on this point. Mr. Perry testified that in order to take care of largely increasing business his company must expend $600,000 for additions and improvements by July 1, 1918. About $400,000 bonds would have to be issued.

Mr. Perry added that since 1914, when the present rates went into effect, his company had not shown a very favorable balance in any year, and that it was not now making money. The Indianapolis Light & Heat Company has about 35,000 residence connections, he said, with an average payment of $1.10 a month. He contended that the company makes nothing from thousands of residence consumers, who pay less than $1 a month. He urged a minimum rate of $1 a month in place of the present minimum charge of 50 cents.

How Far Are Contracts Binding?

Mr. Perry gave testimony regarding clauses in a new coal contract which he has signed, showing the general trend toward price control by the coal operators' association. He said that during December, January, February and March of 1916-17 the coal companies failed to live up to their contracts and the lighting company was compelled to buy 9033 tons (8129 t.) on the open market at an average price of $3.71 a ton, while contract prices ranged from $1 to $1.16. He estimated that the company would consume 154,000 tons (138,600 t.) of coal during the next year. Mr. Perry declared that it might be extremely difficult to force adequate deliveries under contracts as mine operators were contending that contracts bind them to fulfill contract agreements only when mines are in full operation.

H. H. Harrison, president of the Merchants' company, said it was desirable for his company to store between 30,000 and 40,000 tons (27,000 and 36,000 t.) of coal to provide against emergencies next winter, but that storage now is impossible except at excessive costs. Under his contract—and Mr. Harrison testified that he was afraid that it would not be carried out—he had bought screenings last year for from 55 to 60 cents a ton, while screenings on the open market now are up to $2.50 a ton. In the latter part of last November Mr. Harrison declared the coal company with which he had his contract notified him that it would be impossible to fill his contract and that coal must be bought on the open market.

Mr. Harrison said that because of the rise in coal prices his company had been at an excess expense of $123,000 for the year just closed and more than $100,000 of this amount now is the subject of litigation. He estimated that his company this year is paying an average of $2.17 a ton for coal, and it is estimated that it may go to $3.15 a ton.

Both Mr. Harrison and Mr. Perry gave details of many other increased expenses, including additional burdens of taxation. The point was reiterated that the business of both companies is growing rapidly and that they must have sufficient money for necessary extensions.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Safe Place to Work When Making Repairs.—It is the duty of an employer to furnish the employee a safe place within which to work and to provide him with proper tools and equipment, a duty which includes that of making reasonable inspection and repairs, the Appellate Court of Indiana held (116 N.E. 600). Actionable negligence in an employer cannot be predicated on mere failure to inspect, when inspection would disclose only what was known and appreciated by the employee. An employer's duty to furnish a reasonably safe place to work and to use ordinary care to keep it safe is a qualified duty. In a case where the overseer of lines of a telephone company engaged in dismantling a line at the company's direction was injured when a telephone pole which he had climbed broke off at the ground because it was rotten, the telephone company was not liable for the injuries, since the servant was engaged in dismantling work, was experienced and in full charge, and determined for himself whether poles were sound or unsound.

Electric Companies Cannot Maintain Dangerous Wires Near Human Beings.—In the case of Dwight Manufacturing Company vs. Word (75 S.R. 979), the Supreme Court of Alabama approved as sound the following rules of law which are well settled by the most authoritative decisions in this country: (1) The duty of an electric company in conveying a current of high potential to exercise commensurate care under the circumstances requires it to insulate its wires and to use reasonable care to keep the same insulated, wherever it may reasonably be anticipated that persons pursuing business or pleasure may come in contact therewith. This statement of the rule implies that, in the absence of statute or municipal ordinance, it is not necessary to insulate wires which are so placed that no one could reasonably be expected to come in proximity to them. (2) The fact that it may be expensive to place a proper insulation upon electric wires is no excuse for a failure to do so. (3) An electric company maintaining a dangerous wire through or near a tree is bound to anticipate that persons may lawfully climb the tree, and it is bound to exercise due care to prevent injuries to such persons from its wires. (4) The maintenance of a wire through a tree requires frequent inspection, for the company is charged with knowledge that the swaying of the limbs is likely to abrade the insulation and permit the dangerous current to escape. These last two propositions are, of course, to be qualified by the nearness or remoteness of the tree with respect to human beings and their natural and probable associations therewith. (5) From the foregoing it is clear that courts judicially know that even wires carrying very high voltage may be so insulated as to lessen at least materially the danger of shock to those who come in contact therewith. (6) But the extent of such protection and the particular physical conditions, if any, under which insulation may become entirely useless are matters for expert opinion. The merit of the fourth count of the complaint is rested upon the assumption that defendant is guilty of a breach of duty to employees of a telephone company in maintaining and operating a wire carrying a dangerous current of electricity in such proximity to the telephone wires that telephone employees are likely to come in contact therewith while in the proper discharge of their duties; but it is clear that the maintenance and operation of such a wire by defendant is wrongful only when the dangerous proximity complained of is caused by defendant.

Flowage Rights Not Secured by Eminent Domain.—The Supreme Court of New Hampshire, in the case of Thompson & Nesmith vs. Manchester Traction, Light & Power Company (101 A. 212), held that the public service commission act giving railroads and public utilities the right to petition the Public Service Commission to take lands needed for the construction of a line, branch line, extension or pipe line, conduit, line of poles, etc., to meet the reasonable requirements of service to the public, does not give public utilities the power to secure flowage rights by eminent domain, though the words "rights and easements" and "land" in the statute make it broad enough to include flowage rights. Many companies under special acts of the Legislature have been granted the power to acquire flowage rights by eminent domain without paying 50 per cent more than the actual damages occasioned by the flowage. These companies, however, have been largely aqueduct companies for the purpose of supplying towns with water, and some of them were municipal water companies, but the rights granted do not imply the use of water for power. Only a very few of these companies chartered previous to the public service commission act were hydroelectric companies similar to the defendants' company. It will be noted that some of the largest companies of this character that have in recent years been granted the right to obtain flowage rights for power by special legislative act have been required to pay 50 per cent more than the actual flowage damages. Since the passage of the public service commission act in 1911 several public utility companies have been granted by special acts of the Legislature power to acquire flowage rights by paying only the actual flowage damages. If the position of the defendants is correct, there was no occasion for these companies to seek such rights by special acts from the Legislature, and no reason why they should have been granted.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rate of Return in Oregon.—The Oregon Public Service Commission has rendered a decision affecting electric and water rates of the California-Oregon Power Company. The commission found that from its electric operations the company during 1916 had received returns amounting to less than 5 per cent, and from its water operations returns amounting to approximately 5 per cent, and in view of this decided not to make any reductions. The decision said: "The commission is satisfied that the company has not received an unreasonably high return upon its property, but on the other hand has obtained less than investors might reasonably be entitled to expect from investments involving like risks, and less than the prevailing rate of interest throughout the territory. In view of these findings no general reduction in rates is justified, nor is it believed that total returns can be satisfactorily increased by advanced charges. All changes in present tariffs will, therefore, be designed to maintain as nearly as practicable the present total income and to erase any possible unjust discrimination between customers."

Free Service Prohibited by Oregon Commission.—The Public Service Commission of Oregon has handed down a decision against the Home Telephone & Telegraph Company of Portland, Ore., restraining it from placing a supplementary rate schedule in effect whereby no charge is made to new subscribers for residence telephones for the first three months' service. It was contended that by giving three months' free service to subscribers the company would be enabled eventually to increase its revenues without adding to its present expense of operation and without throwing any added burden on its present subscribers, and that new business could thus be procured at a much less expense. It was held by the commission that the inevitable result of such a practice would mean the practical annulment of the utilities act, permit the establishment of a method to stifle legitimate competition, bring ruin to the weaker utilities and in many cases bankruptcy to the one adopting such a method. The public is therefore vitally interested in preventing any practice which would in any way affect the financial condition of such a utility. Any utility which furnishes or offers to furnish service at free or reduced rates, or which makes any concession whatsoever to new subscribers, not only violates both the letter and the spirit of the act, but subjects those to whom such service is furnished to severe penalty.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Municipal System Seeks to Raise Rate.—The cost of running its plant having increased from $7,000 a year to $14,000, the Utilities Commission of Easton, Md., is seeking permission to increase the rates for electric service. A year ago the city contracted for coal at $3.85 a ton which now costs from $7.50 to $8 a ton.

City May Establish Rates.—The Ohio Public Utilities Commission handed down a decision holding that the city of Dayton cannot protest the rate made by the Dayton Power & Light Company, but may, however, establish a rate itself. Should that rate not be satisfactory to the Dayton Power & Light Company, the latter may appeal to the commission to determine the case.

Jovian Insurance Progressing Favorably.—The actual sales up to date of Jovian health and accident insurance policies show a total premium income of about $4,000. While the central office of the Jovian Order has no definite comparative data by which to judge this sales record, the insurance people who are interested in the proposition are entirely satisfied with the progress which is being made. The indications are that Jovians who carry insurance are changing to the Jovian plan at the expiration of the policies which they now hold.

Brooklyn's Electrical Growth.—That the borough of Brooklyn is being developed rapidly is shown by the report of the commercial organization of the Brooklyn Edison company covering sales for the first six months of 1917. Contracts for 18,982 new customers were signed covering light and power customers. By the power customers 32,010 hp. was contracted for. Five hundred and eighty-six old houses were rewired and 494 old stores rewired. If the number of contracts for light in houses and stores be placed on a candlepower basis, it is found that 16,827,502 cp. in light, with the new tungsten units, was contracted for. Over 6650 appliances were sold. In this number have been included more than 1500 electric irons, more than 1000 vacuum cleaners, 500 electric vibrators, 300 heating pads, etc. Thirty-seven independent power plants have been replaced with Edison service during the first six months of the year. A large amount of additional power business was added to existing Brooklyn Edison power customers, the Bush Terminal alone taking nearly 4000 additional, the Rockwood Company 1000 hp. and the Metropolitan Engineering Company 1500 hp. Contracts were taken for wiring more than 1200 new residences.

Electric Vehicles in Shanghai.—United States Consul General Thomas Sammons reports that electric vehicles made their first appearance in Shanghai, China, during the year. The municipal department of electricity bought several cars and trucks and contemplates the addition of others. There are a few private electric cars.

Electrical Equipment of Hotel Commonwealth, New York.—The General Electric Company is to have a part in the construction of the Hotel Commonwealth, soon to rise twenty-eight stories in the Times Square district of New York, under the supervision of Charles E. Knox, consulting engineer. The electrical equipment for power will be sufficient for a city of 20,000 inhabitants. Not only electrical apparatus for the lighting, heating and ventilating but electrical devices for operating and controlling the machinery used in the kitchen, laundry and refrigeration departments, the pneumatic-tube service, vacuum-cleaner system and the various pumps necessary in a building of this type will be furnished by the General Electric Company. This company will also provide the electrical conduits, wires, cables and incandescent lamps. The hotel is to contain 2500 rooms. To be designed, built, decorated and equipped under a single contract originated by W. J. Hoggson, a well-known builder of banks, it will cost $15,000,000, and will be owned and operated on a co-operative basis by more than 100,000 shareholders, each of whom may subscribe for from one to ten shares of stock, value $100.

Energy for Georgia District to Be Supplied by Gregg Shoals Plant.—As a temporary expedient to supply the Franklin district of the Georgia Railway & Power Company centered around Royston, Ga., with hydroelectric power until the ultimately projected line from Tallulah Falls can be built, power is to be purchased from the Gregg Shoals plant, now under lease to the Southern Power Company, and a line will be built from Gregg Shoals to Elberton and from Elberton to Royston for the transmission of this supply. Under the terms of the agreement, an equivalent amount of power will be returned to the Southern Power Company from the Tallulah plant. This arrangement will defer until conditions in the material market improve the heavy expense of connecting Tallulah with the Franklin district by way of Toccoa. The line to be built between Elberton and Royston will become a part of the permanent equipment of the Franklin district, and it is probable that the Gregg Shoals-Elberton line also will remain for the purposes of interchange of power between the Southern Power Company and these companies. Right-of-way for the Gregg Shoals-Elberton line is reported as approximately ready, and right-of-way for the Elberton-Royston line is ready and is being surveyed. Construction will be started as soon as the engineers finish their work.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Missouri Electrical Contractors' Association.—The Missouri Electrical Contractors' Association held its semi-annual meeting at the Colonial Hotel, Springfield, Mo., July 28. Several short talks were made regarding the contracting situation, and it was urged that the members form a closer union between the contractors and architects. F. B. Adams of St. Louis is the president and Robert Baker of Kansas City the secretary of the association.

Iowa Section, N. E. L. A.—The executive committee of the Iowa Section, N. E. L. A., held a meeting at Davenport recently which took the place of the usual annual convention. At this meeting there was a general round-table discussion of topics interesting to the state association, and a great deal of time was spent in discussing the coal situation. R. H. Fowler, assistant secretary, Des Moines, tendered his resignation as he is entering the government service. His work will be carried on in the future by L. E. Caldwell, secretary-treasurer, Iowa City.

Ohio Electric Light Association.—The members of the various committees of the Ohio Electric Light Association for the coming year are as follows: Advisory—W. W. Freeman, Cincinnati; E. P. Matthews, Dayton; F. J. Derge, Toledo. Finance—E. L. Franklin, Warren; Norman McD. Crawford, Columbus; J. H. Scobell, Cleveland. Illuminating—F. C. Caldwell, Columbus; Ware Parsons, Springfield; G. E. Merrill, Cleveland. Meters—G. E. Snider, Toledo; C. P. Gorman, Dayton; Roy Walford, Newark. New-Business Co-operations—Commercial lighting and merchandising—C. E. Yacoll, Youngstown; O. A. Acuff, Massillon; C. H. Felker, Columbus; W. P. Whittington, Springfield; C. J. Eichelberger, Cincinnati. Industrial power, heating and lighting—F. B. Steele, Dayton; W. B. Wilkinson, Newark; C. D. Carlson, Cleveland. Station Operating—H. B. Dates, Cleveland; William Long, Toledo; R. J. Feathers, Columbus; B. G. Sloat, Sandusky; H. W. Bromley, Youngstown; Mr. Aldrich, Cleveland; C. H. Speihler, Dayton; C. W. De Forest, Cincinnati. Transmission and Distribution—M. H. Wagner, Dayton; R. R. Krammes, Newark; W. E. Beatty, Cincinnati; J. B. Johnson, Elyria; C. A. Harrington, Youngstown; M. E. Grah, Toledo; Prof. A. M. Wilson, Cincinnati. Standardization of Voltages—H. L. Wallau, Cleveland; H. B. Dates, Cleveland; C. I. Crippen, Youngstown. The officers elected at the recent meeting of this association were given in the July 28 issue of the ELECTRICAL WORLD.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Thomas Pitts continues as manager of the Northwestern Light & Power Company at Hutchinson, Minn. This company was recently acquired by the Northern States Power Company.

J. W. Campbell, Jr., continues as manager of the Minnesota Valley Light & Power Company, Montevideo, Minn., which was recently acquired by the Northern States Power Company.

Carl Oppen has been appointed manager of the Pipestone (Minn.) district of the Northwestern Light & Power Company, which was recently acquired by the Northern States Power Company.

R. A. Gordon has been transferred from the local managership of the Hamilton (Ill.) branch of the Keokuk Electric Company to become commercial agent of the company, succeeding R. R. Ralston, who has been transferred to Paducah, Ky.

J. H. Prior, formerly chief engineer of the Illinois Public Utilities Commission, has left the service of the

J. H. PRIOR

Illinois Commission to open an engineering office in Chicago. Mr. Prior entered the service of the Illinois Commission about three years ago as assistant chief engineer and a year later was appointed chief engineer. Before that time, during the years 1905 to 1914, Mr. Prior was engineer of design of the Chicago, Milwaukee & St. Paul Railway and was engaged in the design of all structures on that railway and on its 2000-mile (3219-km.) extension known as the Puget Sound Lines. Mr. Prior made two of the earliest valuations of railroad properties required by railroad regulatory and taxing bodies. Mr. Prior was educated at the Armour Institute of Technology and the University of Chicago.

Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company of Louisville, Ky., has passed the examination for admission to the officers' training camp and will go to Fort Benjamin Harrison, Ind., on Aug. 27. His position will be reserved for him until he returns, T. B. Wilson, secretary of the company, taking up the executive duties of the office, while the routine work will be taken up by others.

Rich. D. Whitney has recently been promoted from assistant professor of electrical engineering to associate professor of electrical engineering in Syracuse University, Syracuse, N. Y.

G. W. Atkinson has recently been appointed electrical engineer for the Springfield Armory, Springfield, Mass., after having served eight years in the supervising architect's office, Treasury Department, Washington, D. C.

H. L. Nichols has purchased a controlling interest in the Minnesota Gas & Electric Company at Albert Lea, Minn., and has taken over the active management of the property. He has been elected secretary, treasurer and manager of the company, succeeding F. A. Otto, who has resigned.

R. R. Ralston, for the last four years commercial agent of the Keokuk (Iowa) Electric Company, has been transferred by the operators, the Stone & Webster Management Corporation, to Paducah, Ky., where he will have charge of the new-business department of the Paducah Light & Traction Company.

Adrian Tobias, who has been superintendent of the meter department of the Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, since 1915, has returned to the employ of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., which he left some time ago to take up central station work.

Edward A. Wickes has resigned as president of the Niagara Falls Power Company, the Niagara Junction Railway Company and the Niagara Development Company. Mr. Wickes has been active in the management of the affairs of the power company since its inception in 1890 and has been president of the company for many years. Advancing age led him to seek retirement from active responsibilities.

George A. Harris has been appointed auditor and treasurer of the Edison Electric Light & Power Company of Amsterdam, N. Y., and the Fonda, Johnstown & Gloversville Railroad Company. Mr. Harris has been secretary and general auditor of the electric company and general auditor of the railroad since July, 1907. This promotion is in recognition of his services with both companies for a twenty-five-year period. Mr. Harris is also secretary and treasurer of the East Creek Electric Light & Power Company of St. Johnsville, N. Y. Lyman K. Brown, formerly treasurer of the railroad company, resigned on account of ill health.

Anson Marston, dean of the College of Engineering at Ames, Iowa, has been mustered into federal service as a major in the Iowa engineering battalion.

William A. Bittner, until recently purchasing agent of the Union Electric Company of Pittsburgh, Pa., has severed his connection with that firm to engage in the business of manufacturers' agent. He is associated with Ralph C. Sperry, operating under the name of Sperry & Bittner.

Ralph C. Sperry, until recently Pittsburgh district manager of the Brilliant Electric Division of the National Lamp Works, has severed his connection with that company to engage in the business of manufacturers' agent in Pittsburgh, with William A. Bittner, under the name of Sperry & Bittner.

D. Roy Blaicher, who was purchasing agent for the Minneapolis General Electric Company and all divisions of the Northern States Power Company, has been called to Washington, D. C., to serve on the board of buyers. He will have charge of purchasing all electrical equipment for the various government work throughout the country. Mr. Blaicher's selection came as the result of a sweeping offer made by H. M. Byllesby & Company to loan the government any of their employees during the period of the war. Mr. Blaicher, who is thirty-eight years old, was born in Hamilton, Canada. He has been purchasing agent for the Baldwin Locomotive Company at Pittsburgh, was connected with the service department of the General Electric Company at Schenectady, was purchasing agent for the Toronto Electric Light Company, and was later employed in the purchasing department of the Toronto Street Railway Company and the Toronto Power Company. In 1913 he entered the employ of the Minneapolis General Electric Company as purchasing agent, and during the last two years he has supervised the buying of all material for the Northern States Power Company, as well as for the Minneapolis company. Mr. Blaicher is an active worker in Jovian and N. E. L. A. affairs and is at the present time treasurer of the Association of Edison Purchasing Agents.

D. ROY BLAICHER

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

JOBBERS AND MANUFACTURERS TIGHTENING UP ON CREDITS

Considerable More Capital Is Now Required than Formerly to Do Business—Accounts Collected Promptly Where Possible

A factor which is becoming of considerable consequence is the tendency of some dealers in electrical equipment and fittings, particularly retailers, to endeavor to obtain increased credit. The credit men of the different concerns are watching this situation very closely, because this demand for increased credit does not necessarily mean increased business or an increase in the quantity of goods sold. In fact, it has been stated that in some lines the purchaser "now requires from 50 to 100 per cent more capital to do business than was necessary two or three years ago. The merchant may not have this capital. Therefore, instead of borrowing, he is prone to expect the wholesaler to carry him and in many instances tries to enforce this requirement. The wholesaler is in no better condition than the retailer. Raw materials in many instances have advanced from 100 to 500 per cent, and it follows that the wholesaler is in no position to assume the load of the retailer as well as his own." Hence, in view of the fact that prices are still advancing and that they will probably continue to advance, the tendency is not to grant extensions where it can be avoided. The policy of the more conservative concerns appears to be to collect accounts promptly when they are due wherever it is possible to accomplish this.

RIGID CONDUIT MARKET IN SOUTH AMERICA

Any Big Development in Electrical Exports to West Coast Must Come as a Result of Investment of American Capital

The following is taken from a recent report of P. S. Smith, special agent of the Bureau of Foreign and Domestic Commerce, investigating opportunities for trade with South America in electrical goods:

"There is no market for rigid conduit in Ecuador, Peru or Bolivia. Several reasons may be given. There are no rules or regulations covering electrical installations which would require the use of conduit. That being the case, no one is going to put in the material when it only adds to the cost of his installation without giving him any advantage. In fact, it would be a disadvantage, because every householder does most of his own wiring and wants to have the wires exposed, so that he may get at them easily. There is no advantage in any of these countries, with the possible exception of cases in the city of Guayaquil, in using conduit as a protection against fire caused by damaged wires, as all the houses, including inside walls and partitions, are made of adobe or volcanic rock, both of which are noninflammable. It would be necessary to run the conduit on the outside of the walls—that is, not concealed as is the practice in frame houses—and the flexible cord which is universally used for house wiring is less conspicuous. The high cost of the steel conduit laid down in these countries, on account of freight and duty charges, is quite prohibitive. It is largely for this reason that not even the European systems of tubing are used to any extent.

"Rigid conduit is in favor only in connection with companies which are formed with American capital and manned by American engineers. So far as the three countries mentioned are concerned, it is a waste of time for any one to try to sell material of this sort to any company except one that is run on American capital. If any big development in our electrical export trade is to take place on the west coast of South America it will come as a result of the investment of American capital in mines, railways, electric companies and general mercantile stores, which will be truly American selling agencies, and not jobbers who pretend to handle American goods but in reality hold agencies for manufacturers in the States while making attempts to sell only the products of other countries."

CANADIAN ELECTRIC IMPORTS IN 1916-17 ARE $6,342,490

United States Furnished 97 Per Cent of the Total During the Fiscal Year Which Ended March 31 Last

Figures are now available showing the foreign trade of Canada for the fiscal year ended March 31, 1917. The total imports of electrical merchandise during that period were $6,342,490, as compared with $4,896,106 for the corresponding period a year previous. Of the 1916-17 total, $176,700 came from the United Kingdom and $6,149,342, or 97 per cent, from the United States.

While these figures show that virtually the entire amount of Canadian electrical imports originated in the United States, they do not show the extent to which Canada depends on electrical goods manufactured under supervision of interests in the United States. Many of the larger manufacturers in this country have Canadian branch factories where electrical goods for Canadian consumption are produced. The goods are identical with those manufactured in the States. They are made in Canada so as to avoid import duty.

UNIFORM ACCOUNTING FOR WASHING-MACHINE PRODUCERS

Believe That It Will Make for Particular Convenience in Applying for Credit to Federal Reserve Banks

Seventy-five delegates, representing fifty different manufacturers, attended the meeting of the American Washing Machine Manufacturers' Association held at the Hotel Sherman, Chicago, not long ago. President Sam T. White of Davenport, Iowa, presided. It was decided to make use of the Federal Reserve bulletins on uniform system of keeping accounts, with the feeling that this will make for particular convenience in applying for credit to banks holding membership in the Federal Reserve system. The question of trade acceptances was also discussed, the discussion ending with a resolution favoring their use by every member of the association.

Of special interest to the manufacturers were the reports presented by Raymond Marsh, secretary of the association, who has made several trips to Washington to ascertain the attitude of the government toward the washing-machine industry. Mr. Marsh assured the delegates that the Council of National Defense believes there will be no shortage of materials for the remainder of 1917. An instructive paper on the subject of billing, invoicing and handling of customers' accounts was read by Howard Power of the White Lily Manufacturing Company, Davenport. Mr. Power expressed his opinion, based on long ex-

perience, that there is a tendency on the part of manufacturers to ship on too low ratings. He advised more caution and care in handling low rating accounts.

GERMAN MANUFACTURERS FIX PRICE INCREASES

Quoations Based on Practice Followed Before the War and War Practice Using Substitute Metals

From information recently published in German papers it is learned that the eleven leading electrical manufacturers of Germany are working together for the purpose of fixing prices on common accounts. This is reported in the London *Electrical Review*, no German papers having reached this country for many months. The report states that at the present time the conditions in the market for castings, sheet insulating materials, etc., are such that almost all the firms that supply these state that they are unable to accept orders at definite prices. The prices for raw materials in Germany are now quoted as of the date of delivery, and for that reason the electrical manufacturers have been compelled to quote in the same way. In order, therefore, to inform a customer of the situation of prices within a certain period, these eleven firms have undertaken to issue circulars to their customers in the future.

In these circulars, it is stated, the situation of prices at any time will be expressed by war price increases on certain basic prices. Basic prices for manufacturers made according to the prices followed in peace times are considered to be the prices which prevailed before the war, copper, brass, bronze, etc., being used; for machinery and other manufacture with substitute metals—iron, zinc aluminum, etc.—also, the basic prices are those which ruled for materials and wages before the war.

These firms fixed for June of this year and for manufactures for which definite prices could not be quoted four war-price increases, which vary according as to whether the orders are executed by peace-practice or war-practice methods, as shown in the table. Three of these relate to peace practice; that is, using copper, brass, bronze, etc. The fourth increase applies to the war method of execution with substitute metals.

PERCENTAGE INCREASE ON BASIS OF PRE-WAR PRICES

	No. 1: Direct War Orders Executed According to Peace Time Practice with Copper, Brass, Bronze, Etc., Per Cent	No. 2: Indirect War Orders for which Copper, Brass, Bronze, Etc., Are Released by the Government for Each Order, Per Cent	No. 3: Orders for Peace Purposes, Per Cent	No. 4: Orders with Substitute Metals (Iron, Zinc, Aluminum, Etc.), Per Cent
Small motors up to 5 kw. (1000 revolutions), including crane and lift motors etc.	125	140	200	35
Generators and motors over 5 kw. and up to 100 kw. (100 revolutions)	150	165	210	100
Generators and motors of over 100 kw	160	175	230	110
Electric locomotives	160	170	190	140
Turbo-generator sets	140	145	....	....
Steam turbines	140	145	....	....
Starting switches, regulating resistances, etc	125	140	180	125
Transformers (not oil-insulated)	150	165	225	150
Switching apparatus	110	125	170	100
Switchboard fuses and high-tension fuses	115	130	200	115
Excess voltage protecting apparatus	120	135	190	120

It is explained in the German account that the electrical firms receive supplies of copper and copper alloys from the controlling departments at fixed prices for classes Nos. 1 and 2, these being higher for No. 2. In the case of class 3, and in so far as orders for peace purposes can be carried out, it is mentioned that for these must be used exclusively any stocks released for this purpose, supplemented as far as possible by imports. The State War Department make no range of prices for substitute metals, while materials for the manufacture of cables are allotted for each other, and the customer is charged on the basis of the prices paid for these materials.

THE WEEK IN TRADE

THE repressing effect of existing uncertainties has become more sharply defined, and in some of its most important branches business is characterized by rather more than the usual midsummer halting. With the continued doubts about prices, and with the widening scope of the export embargo, the quietness natural at this season is intensified. Not only buyers but also sellers are in many instances disinclined to commit themselves further pending a clearer insight into the future, and in steel, lumber, textiles and elsewhere governmental purchases take precedence over all other requirements. Despite its various drawbacks general business remains in a strong position and the absence of heavy speculation is encouraging. As far as the metal market is concerned, things seem to have come to a standstill.

All interest centers in Washington, and advices from there say that many manufacturers and producers of war materials are ranging themselves to oppose the administration program of the same prices to the Allies as to the United States.

NEW YORK

Trade conditions remained quiet in the New York district during the past week. Prices changed but slightly, owing to the general uncertainty of business conditions and the continued doubt about prices. The labor situation is improving, but it is expected that the draft will affect a great many factories. Stocks are being replenished rapidly and deliveries of raw materials to manufacturers are improving.

Jobbers and manufacturers are tightening up on credits, accounts being collected as promptly as possible. It is said that in many lines purchasers require from 50 to 100 per cent more capital to do business than was necessary two years ago.

SAFETY SWITCHES.—There is a heavy demand for safety switches, with manufacturers' stocks in fair condition.

FANS.—Owing to the cooler weather the demand for fans has slackened. Stocks are in fair shape.

SECOND-HAND MACHINERY.—The demand for this type of machinery is larger than ever before, and high prices are being obtained in all lines. The heavy demand is due to the inability of manufacturers to make deliveries in many lines of equipment.

LINE MATERIAL.—Demand for insulators heavy, with deliveries slow. Other line material is reported to be moving more slowly.

FIXTURES.—Building activity remains about the same, stocks in good condition.

STORAGE BATTERIES.—Manufacturers are enlarging plants because of heavy demand. Automobile manufacturers continue to place heavy orders for batteries and ask for rapid delivery.

WIRE AND CABLE.—Stocks in smaller sizes of wire in poor shape because of recent heavy demands, but show signs of picking up as demand slackens. Deliveries on power cables are slow.

CREDITS AND COLLECTIONS.—These continue good and prospects for collections during August are better than ever before.

LAMPS.—Certain of the Eastern incandescent lamp factories, because of the expensive additional equipment which will be in effective operation in the near future, are again preparing to make strenuous efforts to sell incandescent lamps. It is generally understood that certain manufacturers have not been pushing incandescent lamp sales very hard because they could not deliver the lamps; but this condition has, in certain instances, now been corrected and aggressive sales campaigns will be inaugurated. Factory stocks are known to be increasing.

CHICAGO

When war broke out some one immediately came forward with the slogan "Business as usual." Important financial men at once pointed out that, while there would be business in plenty, it would not be "as usual." An attempt to discover wherein business is not as usual in the Chicago territory this week developed the following interesting situation:

Distributers of electrical supplies in general have two barometers by which they gage business. One barometer registers the volume of material; the other registers dollars and cents. The latter shows "fair weather"; the former does not present such an optimistic outlook. It may be said definitely that central stations and electrical contractors are not buying so heavily as they were at this time last year. This is probably due in part, as far as the central stations are concerned, both to the war and to high prices. The contractors' business is being influenced by prices of material and unfavorable labor conditions. The volume in dollars of the distributers' business is therefore being held up, not by business as usual, but by government orders and the like.

Nevertheless, distributers in their buying have been optimistic. They have on hand stocks of fall lighting equipment bought on the basis of 1916 sales. There is a conviction that this class of goods will soon begin to move.

RUBBER-COVERED WIRE.—Some distributers have dropped from a 39-cent to a 35-cent base, while others have held at 37 cents. This is taken not so much as an indication of a falling market as of the fact that at the 39-cent base certain distributers were endeavoring to hold off business. They are now in a position to take on business and have dropped to the lower base to get it. This is another indication of the spotty condition of the market in the Chicago territory.

LIGHTING FIXTURES.—Business in lighting fixtures has fallen off considerably in Chicago, owing to the fact that practically no building is going on. In the first week of August there was one day on which only one building permit was issued.

BAKE OVENS.—In the electric heating field the bake-oven business is claiming first attention of manufacturers.

HEATING APPLIANCES.—There will be another advance in the prices of heating devices, with the exception of flatirons, on Sept. 1. Agents of some devices manufactured in the Chicago territory report gross business satisfactory but volume not so great as in 1916. They see retail buying falling off.

WASHING MACHINES.—The demand continues steady and the factories are being operated at top speed.

BOSTON

Jobbing interests report a moderate recession in business this week, although in exceptional cases trade is extremely active. Prices rule at substantially last week's levels, but it is rumored that a reduction in the price of rubber-covered wire is in early prospect. Electrical manufacturers as a whole are still finding it difficult to accumulate extensive stocks, and the recent extreme heat cut down production temporarily on account of the need of closing plants in the middle of the day to safeguard the health of employees. With more seasonable weather conditions full-time operation resumes. In some lines deliveries are improving. Parallel with the slight recession in demand for new products a perceptible falling off is seen in the market for second-hand electrical equipment and machinery. Collections are reported as better, and one representative Boston jobber states that these are at present in splendid shape. Although business conditions are now largely a matter of deliveries, no immediate increase in the price of central station electrical supplies is anticipated.

WIRE AND CABLE.—Demand continues about the same, with a tendency at present to fall somewhat behind in production and factory stock.

LAMPS.—Very little change appears in the lamp situation compared with a week ago. Prices remain virtually unchanged, and no immediate increases are forecast.

FANS.—Jobbers report exhaustion of stocks by the recent heated spell; retailers were also pretty thoroughly cleaned out, and a large central station reports that its fan sales will exceed last year's, although fans have been sold only on the charge or cash basis, the former custom of deferred payments being given up.

ELECTRIC RANGES.—In recent weeks the sale of these shows an increase, and the prospects for a good August record are excellent. One central station in Massachusetts has averaged seventeen ranges a week in three weeks recently passed.

FLATIRONS.—These are moving well, despite the fact that the warm weather caused a virtual stagnation of business in the larger cities, with the minds of families on draft numbers rather than on the purchase of electric appliances.

AUTOMOBILE STARTING AND LIGHTING SETS.—An increased demand for these equipments is noted by manufacturers since Aug. 1.

STORAGE BATTERIES.—Deliveries are improving, owing in some cases to better facilities for securing raw material and to factory expansion.

ELECTRICAL MACHINERY PRODUCTION.—Large manufacturing interests report capacity orders and continued demand for full production in all important lines, with shortage of labor, both skilled and unskilled.

ATLANTA

Reports from individual jobbers in Georgia, North and South Carolina and Virginia indicate business in all lines for June and July as being the best they have ever had. While cantonments in the states mentioned are making abnormal drafts on the industry, there seems to be no slackening in normal requirements and a very healthy condition prevails.

Good progress is reported on the Columbia (S. C.) cantonment and 40 per cent of the ultimate work for all trades has been completed. The exterior wiring at Charlotte, N. C., is progressing rapidly. Rows of poles are being set up back of proposed tent streets with the idea in view of serving from four to six tents from each pole. The secondary leads will be of sufficient length to handle all cut-ins without difficulty.

LAMPS.—Jobbers report an improvement in the lamp situation with increasing demand from industrial sources.

ELECTRIC RANGES.—Almost dormant as compared with last year.

BELLS AND GONGS.—A price advance of 15 per cent has been registered in the last ten days, but this line continues normal.

LABOR.—There is no indication of a scarcity of electrical workers at this time, and all government and industrial work is progressing without delay. Wages are comparatively higher than three months ago.

SWITCHES, SOCKETS AND RECEPTACLES.—The demand for all lines of general supplies is excellent and deliveries are holding up well.

CONDUIT.—Deliveries are getting longer on both the white and the black enamel rigid products, and there is a slight tendency to draw on the flexible-conduit stock temporarily. Small lots are being quoted at list plus.

SPECIALTIES.—The demand for the household varieties shows a gain over last week.

HEATING DEVICES.—Toasters seem to be the only article showing any strength at this time.

FANS.—The last few weeks of seasonable weather have increased sales materially. The delayed seasonal weather and long deliveries have given a few dealers the opportunity to cancel orders. The South has experienced rainy weather for the last week, and temperatures considerably below normal. This has again slowed up fan sales.

POLES.—Cantonment requirements and industrial extensions have created an abnormal demand and deliveries are slowing up.

CROSS-ARMS.—In spite of a 10 per cent price advance Aug. 1 the demand is very strong.

ST. LOUIS

Business is holding up and executives continue to be optimistic. As an index on general business conditions in this territory, the postmaster of St. Louis announces that the business of the office for the past month has been the greatest in its history.

No decreases in prices on electrical equipment or supplies have been reported to the ELECTRICAL WORLD. On the other hand, some advances, notably in porcelain insulators, rail bonds and switchboard accessories, have been announced in the week. The general feeling seems to be that prices have about reached the maximum limit. Two reasons for this are advanced. One of them is that purchasers, except where absolutely necessary, are declining to buy at the present prices and hence will show greater hesitancy in buying at increased prices. The second is that the price-control movements inaugurated in Washington by legislation and otherwise will ultimately have some effect on all commercial lines. There has been no appreciable change in collections. They continue to hold up well. One manager says that "people are paying who never paid before." This, of course, is an exaggeration, but it indicates the general sentiment.

For some unaccountable reason the labor situation as regards manufacturing-shop help appears suddenly to have improved. One morning last week forty men applied for jobs at the gates of one of the electrical industrial plants, whereas the applications previously received at the same plant had been discouragingly few. Deliveries on raw materials to the manufacturers seem to be gradually improving.

FARM LIGHTING OUTFITS.—Threshing of the wheat in this territory has been completed, and the yields are even greater than anticipated. The outlook for the sales of electrical equipment in farming communities is excellent.

WIRE AND CABLE.—The general situation is unchanged. No large orders or large receipts of material have been discovered.

TRANSFORMERS.—The smaller manufacturers of transformers seem able to offer materially better deliveries than some of their larger competitors. Because of this fact a number of orders, it is said, have been obtained in this territory recently by the smaller concerns.

FAN MOTORS.—The fan season is about over. On the whole, it has been disappointing, and, as has been predicted, it is almost certain that dealers and jobbers in this territory will carry over some fans into next season.

COAL-MINING EQUIPMENT.—This type of equipment continues to be in great demand, provided prompt delivery can be obtained. It is understood that at least one concern was compelled to decline substantial orders for this apparatus because it could not meet the delivery requirements of the would-be purchaser.

SEATTLE

The labor strike continues to affect material conditions in the Northwest adversely. The failure of the conference to end the strike, which has tied up practically all of Washington's logging camps and lumber mills, closed a normal week in business. Lumbermen give assurance that all demands of the government in its war preparations will be promptly met as received. Shipbuilding operations are going ahead uninterrupted. Electrical dealers and jobbers report no particular change in prices as compared with last week. A little uncertainty exists, however, not that it is expected business will drop off, but rather as to how much business the trade should prepare to care for. Dealers are fearful of overloading, knowing that a decrease in prices is certain. Generally it is believed that the peak in prices has been reached. Demand in most cases, excepting lumber and milling industries, is about the same as reported for last week.

POWER EQUIPMENT.—The demand for motors, turbines and generators far exceeds the supply on a majority of types. Deliveries are slow owing to the heavy demand on factories.

LINE MATERIAL.—The demand for maintenance work is light, proposed improvements and extensions being held up until prices on materials decrease. Utility companies feel that return from heavy investment would not justify expenditures.

POLES AND CROSS-ARMS.—These are hard to obtain owing to lumber conditions. The demand is light.

WIRE AND CABLE.—The demand is light; prices firm, but expected to increase.

FIXTURES.—The demand for fixtures continues light because of the scarcity of building. Deliveries are fairly good.

LAMPS.—Shipyards and public utility companies are buying a considerable amount of carbon lamps. Deliveries are comparatively easy to obtain.

SAN FRANCISCO

Although practically no new building construction is in prospect, and slack conditions attendant upon such inactivity have been anticipated, yet the completion of work under way is keeping up the trade volume and the expected falling off has not yet actually commenced. Payments from large and small concerns are coming in promptly, and on the whole the situation is very satisfactory. Since the organization and general educational movement among contractors and dealers has improved conditions, it has been possible for jobbers to sell more generally on terms making payments coincident with the completion of contracts. This has helped to stabilize trade conditions. It is notable that the retail trade shows no evidence of a tendency on the part of consumers to forego luxuries. For example, one representative San Francisco firm reports more percolator sales in the fifteen-dollar style than in the styles at $6 and $8. Retail trade is now as brisk as before our entry into the war, and retailers are realizing a larger percentage of profits. Prices are practically unchanged since last week, and the demand for all household labor-saving devices continues brisk. The opening of the irrigation season has increased the demand for small motors and transformers, but there are practically no stocks on these lines, and deliveries are slow and uncertain. For the first time in many months labor in the electrical field is plentiful, owing to the inactivity in building construction.

METAL MARKETS INACTIVE

Copper Dull and Easier—Other Metals Remain Unchanged—Metal Markets Quotations

The metal markets displayed little activity during the past week. It is rumored that the price the government may have to pay for copper will probably be more than 20 cents. It is understood that this price is based on the higher cost of production, principally through the higher prices paid for labor and the uncertainties in the labor situation. At present the shortage of labor is a serious menace to the production of copper and adds considerably to the cost. Many refineries are running half time.

Prompt and August electrolytic is offered at 27 to 27.50 cents, September at 26.50 to 27 cents, October at 26 to 26.50 cents, and last quarter at 25 to 26 cents.

NEW YORK METAL MARKET PRICES

	Aug. 6	Aug. 13
	£ s d	£ s d
Copper:		
London, standard spot	125 0 0	125 0 0
Prime Lake	29.50 to 30.00*	28.50 to 29.50*
Electrolytic	28.00 to 28.50*	27.00 to 27.50*
Casting	26.50 to 27.00*	26.00 to 26.50*
Wire base	33.00 to 33.50*	33.00 to 33.50*
Lead, trust price	11.00	11.00
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	8.55 to 8.67½	8.67½
Tin, Straits	63.60	62.50*
Aluminum, 98 to 99 per cent	46.00 to 48.00*	46.00 to 48.00*

OLD METALS

Heavy copper and wire	24.00 to 24.50	25.00 to 26.00
Brass, heavy	15.00 to 15.50	15.50 to 16.25
Brass, light	12.50 to 13.00	13.50 to 14.00
Lead, heavy	8.75 to 9.00	9.00 to 9.25
Zinc, old scrap	6.25 to 6.50	6.25 to 6.50

*Nominal.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard package or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists to contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List, per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 solid:	
Less than coil	$54.90 to $61.00
Coil to 1000 ft	48.80 to 59.17
No. 12 solid:	
Less than coil	63.90 to 71.00
Coil to 1000 ft	56.80 to 68.87

Twin-Conductor

No. 14 solid:	
Less than coil	$78.00 to $104.00
Coil to 1000 ft	75.00 to 80.00
No. 12 solid:	
Less than coil	121.50 to 135.00
Coil to 1000 ft	108.00 to 130.95

DISCOUNT—CHICAGO

Single-Conductor

Less than coil	+10%
Coil to 1000 ft	—10%

Twin-Conductor

Less than coil	+10%
Coil to 1000 ft	—10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	—10% to 12%
1/5 to std. pkg	10% to 20%
Std. pkg.	34% to 44%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to 12%
1/5 to std. pkg	10% to 20%
Std. pkg.	34% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28	.29

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 30	.35	.35
50 to barrel	.31 to .31¾	.32 to .32¾
Barrel lots	.28 to .28¾	.29 to .29¾

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
⅜	250	7.50
½	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$67.50 to $75.00	$60.00 to $69.75
⅜-in. double strip	71.75 to 75.00	63.75 to 72.00
½-in. single strip	90.00 to 100.00	80.00 to 93.00
½-in. double strip	95.00 to 100.00	85.00 to 96.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 100 Ft.
⅜-in. single strip	$75.00	$63.75
⅜-in. double strip	78.75	71.25
½-in. single strip	100.00	$65.00 to 85.00
½-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2¼	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$55.00	$24.50-$25.50	$21.50-$24.75
¼-in.—	$40.00-$60.00	$27.00-$30.00	$23.50-$27.00

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$36.67-$55.00	$25.50-$27.50	$24.75
¼-in.—	$40.00-$60.00	$30.00	$27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot	Couplings, List	Elbows, List
¼	$0.08½	$0.05	$0.19
⅜	.08½	.06	.19
½	.08½	.07	.19
¾	.11½	.10	.25
1	.17	.13	.37
1¼	.23	.17	.45
1½	.27½	.21	.60
2	.37	.28	1.10
2½	.58½	.40	1.80
3	.76½	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	6% to 8%	8% to 10%
2500 to 5000 lb.	9% to 11%	11% to 13%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	3.8% to 7.8%	5.8% to 9.8%
2500-5000 lb.	6.8% to 10.8%	8.8% to 12.8%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

Net	$3.50

CHICAGO

Net	$3.75 to $4.20

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.75 to $6.30
1/5 to std. pkg.	4.50 to 5.25

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.05

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $34.88
Coil to 1000 ft.	21.00 to 26.52

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$37.20 to $37.84
Coil to 1000 ft.	27.90 to 28.38

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$18.00 to $29.00

CHICAGO

Net per 100	$15.00 to $30.00

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, A.X. 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	List to 33%	List to 27%
$10.00 to $50.00 list	List to 42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$14.00 to $20.00
1/5 to std. pkg.	13.00 to 15.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80 to $18.00
1/5 to std. pkg.	13.00 to 14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

5½ N.C.—Solid Nail-it—N.C.

Per 1000 Net	Std. Pkg. 3500.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$10.50 to $24.30	$28.00
1/5 to std. pkg.	9.75 to 12.15	21.50

CHICAGO

5½ N.C.—Solid Nail-it—N.C.

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
Less than 1/5 std. pkg.	$11.85 to $18.00	$20.75 to $30.75
1/5 std. pkg.	9.00 to 11.40	16.30 to 24.30

SOCKETS AND RECEPTACLES

	Std. Pk.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15% to 20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%

SWITCHES, KNIFE

250-Volt, Front Connections, No. Fuse

High Grade:	List
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

High Grade:	
Less than $10 list	List to—5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%
Low Grade:	
Less than $10.00 list	5% to—5%
$10.00 to $25.00 list	11% to 16%
$25.00 to $50.00 list	14% to 24%

DISCOUNT—CHICAGO

High Grade:	
Less than $10 list	—5%
$10 to $25 list	—11%
$25 to $50 list	—14%
Low Grade:	
Less than $10.00 list	+ 5%
$10.00 to $25.00 list	—16%
$25.00 to $50.00 list	—24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp., three-point	100	.54
10-amp., three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	.50	.70
10-amp. double-pole	.50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	20% to Net
1/5 to std. pkg.	15% to Net
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 23%	18%
$2.00 to $10.00 list	20% to 23%	18%
$10.00 to $50.00 list	23% to 30%	18%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

Net price	$3.10 to $3.50

CHICAGO

Net price	$3.35 to $3.50

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

No. 18, less than full spools	$0.52
No. 18, full spools	0.48

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.565 to $0.65
No. 18, full spools	0.495 to 0.55

WIRE-RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-18.00	$12.00-14.50	$11.50-12.50
12	21.06-28.35	18.96-24.30	18.01-20.25
10	29.60-39.83	26.64-34.14	25.31-28.45
8	42.40-56.49	38.16-48.42	36.25-40.35
6	72.19-89.39	64.98-76.62	61.73-63.85

CHICAGO

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$16.00	$14.00
12	28.08-29.89	24.02-25.62	21.35-22.46
10	39.24-41.51	33.57-35.58	29.65-31.39
8	56.07-60.13	47.97-51.50	42.95-44.86
6	75.24-82.20	64.37-75.35	60.19-60.50

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$40.25 to $45.00
25 to 50 lb.	39.25 to 42.00
50 to 100 lb.	38.00 to 38.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$42.35 to $45.50
25 to 50 lb.	41.35 to 44.50
50 to 100 lb.	40.35 to 43.50

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Single-Point Screw-Type Bracket

The National Metal Molding Company of Pittsburgh, Pa., has added to its line of wall brackets a single-point screw-type bracket like the one shown. The insulator on this bracket is of the same design as on other brackets made

ADAPTABLE FOR SUPPORTING WIRES TO WOOD SURFACES

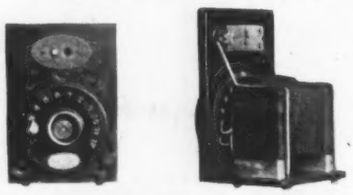
by this company; the necessity of using "tie-wires" has been entirely eliminated, and it is intended that the wires be threaded through "iron-bound" insulators, very similar in construction to strain insulators. The design of the insulators, however, is such that "tie-wires" may be used when desired.

This bracket, it is claimed, is especially adaptable for supporting wires to wood surfaces. A 2-in. (5.08-cm.) No. 20 wood screw is firmly attached to the sherardized base, in such a manner as to entirely eliminate the possibility of its turning or pulling loose. The bracket is rugged in construction and also neat in appearance.

Variable-Speed Controller

The Northwestern Electric Company of Chicago has brought out a controller for printing-press motors. The controller is built in 1-hp. and 6-hp. styles. The 1-hp. type consists of a push-button switch, a transformer and an indicating dial. By means of the transformer the speed of the motor is varied by changing the applied voltage in 5.5-volt steps.

The 6-hp. controller is similar to the 1-hp. unit except that it is arranged for reversing and for inching the



FRONT AND REAR VIEW OF CONTROLLER FOR 1-HP. MOTOR

motor. A triple-pole, double-throw switch is connected so that two blades are used for the series field, and the third blade is connected to the no-voltage release coil on the magnetic switch. When the pointer on the control dial is in the inching position, the third blade of the switch is open. When the starting button is pressed under these conditions the machine starts, but is immediately stopped because no current is passing through the no-voltage release coil.

"Unit Type" I-Beam Busbar Support

In many installations it is necessary to support buses from I-beams, and for this service the "unit type" equipment will be found desirable. The insulator base is provided with adjustable clamps which securely grip the beam, and after being placed in position is firmly locked by means of steel set screws so

I-BEAM BUSBAR SUPPORT

located as to bind the base to the beam. Two sizes of base are supplied, the smaller designed to clamp any size beam up to 8 in. (20 cm.), the larger clamping any beam between 8 in. (20 cm.) and 24 in. (60 cm.). When beams vary in depth, they cannot ordinarily be used for supporting straight runs of bus. By using pipe extensions of suitable length in connection with these supports, the buses can be run straight. These supports, made for all voltages up to 44,000, are manufactured by the Delta-Star Electric Company, Chicago.

Reversible Split Knob

The Findlay Electric Porcelain Company of Findlay, Ohio, has brought out a reversible knob with two available wire grooves and an interlocking feature which keeps the pieces in place while the knob is being installed. It has liberal screw protection and can be installed with screws or nails. The wire way is triangular, insuring a tight grip.

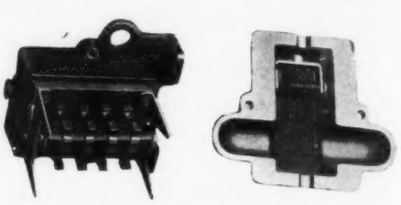
Alternating-Current Oil Switch for Reversing Service

Oil switches for use with small alternating-current motors which can be started by connecting them directly to the supply current have been developed by the Crocker-Wheeler Company, Ampere, N. J. The moving contacts are mounted on a fiber-insulated rod. These moving contacts make contact with the center row of stationary contacts and one of the outside rows of contacts when the switch is in the "forward" position and with the center row of stationary contacts and with the other outside row of contacts when the switch is in the "reverse" position. This switch movement gives a very large break on two points per pole.

The moving contacts are free to turn on their axis so that a new contact surface is continually presented to the fixed contacts, thereby prolonging the life of the switch. The contacts are easily removable and of copper of liberal size. The tank holding the oil in which the contacts are immersed is bolted to the upper part of the switch. Oil cannot splash into the wiring chamber under ordinary conditions of use. A removable cover permits easy access to the terminal board, which is provided with heavy binding posts. No special ells or fittings are required in the case of conduit wiring.

These switches can be furnished with or without latches for holding the contacts securely in the desired position. No latches are needed where the switch handle is operated by an arm or rod for controlling from a nearby point. Such an arm or rod has sufficient friction with its supports to serve for holding the switch contacts in the proper position.

The normal rated capacity of these switches are four-pole, 20 amp. per pole.

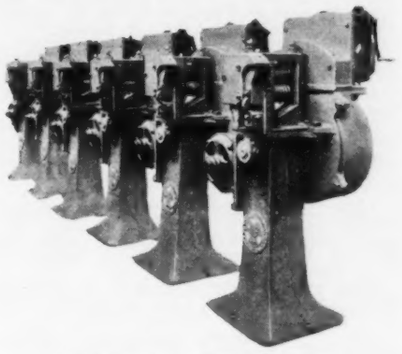


INTERIOR OF CONTACT SECTION AND OIL CHAMBER

suitable for use with motors up to 5 hp., 220, 440 or 550 volts, two-phase or three-phase, and three-pole, 40 amp. per pole, suitable for use with motors up to 10 hp., 220, 440 or 550 volts, three-phase, and with motors up to 10 hp., 220 and 440 volts, two-phase, three-wire.

Motor-Driven Wire Pointers

For those wire-drawing shops which prefer individual motor drive, the Morgan Construction Company of Worcester, Mass., has arranged to supply its wire-pointing rolls with Westinghouse motors mounted on the frame. This



BATTERY OF WIRE POINTERS

makes the unit very compact, since there are no external apparatus and no overhead connections. It is also easy to start and stop by means of the conveniently located starting-box handle.

The wire pointer consists simply of a pair of rolls revolving so as to feed material toward the operator. There are a number of grooves to care for various sizes of wire. The cross-section of these grooves diminishes around the circumference, so that the end of a wire placed in the open part of a groove is pushed back by the rolls and reduced into a tapering end. This pointed end is then threaded through the die in which the wire is to be drawn down. The motor illustrated is a type CS induction motor of 3 hp., 1700 r.p.m.

Cleat-Wiring Devices with Concealed Terminals

The Arrow Electric Company of Hartford, Conn., has brought out two devices for cleat wiring, one a plain porcelain fuseless rosette, the other a base for the Arrow 20 interchangeable brass-shell line. These devices have concealed terminals. With this base it is possible to make a complete line of sockets, key, keyless and full, with all modifications, such as "Arrolock" extension attachment, etc., also a complete line of pull switches, bottom outlet, etc.

Electric Grill with Three Heats

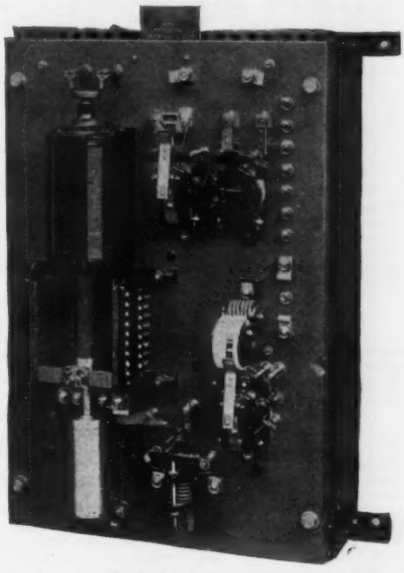
With the radiant electric grill made by the Hotpoint Electric Heating Company, Ontario, Cal., three heats are provided. Food may be started on the "high" heat, and when brought to the boiling point the "medium" or "low" connection may be used to complete the cooking. A composition switch plug with three receptacle positions provides for the changing of heats. It is pointed out by the manufacturer that by placing food both above and below the heating element two cooking operations may be carried on at the same time.

Toy Motor

The A. C. Gilbert Company of New Haven, Conn., has developed a die-cast toy motor which incorporates a number of interesting features. This motor, it is said, has been designed as a rugged toy for operation on batteries. It has a reversing switch attachment so that it is a practical unit for all purposes for which a toy motor could be used, and in addition can be used for practical work requiring a motor of small rating for operation on a battery

Compensated-Solenoid Push-Button System

A push-button system of motor starting and speed regulation, based on the fact that the pull of an electric solenoid varies according to the position of the plunger, has been developed by the



COMPENSATED SOLENOID-TYPE STARTER AND SPEED REGULATOR

Igranic Electric Company, Ltd., London, England. When the plunger is out to the full extent the pull is comparatively weak, and it grows stronger as the plunger is drawn in. In order to produce a controller of which the contactor will remain in any position, it is necessary to compensate the solenoid so as to make the pull equal throughout the whole travel of the plunger.

In this controller the solenoid is so compensated with the result that the same pull is always exerted on the movable contact maker when the solenoid is excited, no matter whether it is on the lowest or the highest or any intermediate contact. In addition to the solenoid and cross-head contactor, a magnetically operated clapper switch is mounted upon the slate base and is used to open and close the motor circuit.

A master switch with four buttons is furnished. If the starting button be depressed, it excites the clapper switch coil and causes it to close the motor circuit, and the clapper switch will remain closed after the pressure is withdrawn. But if the depression is only momentary, the accelerating solenoid, which controls the movement of the cross-head, is not excited. By means of the "start" button, the motor can be either started or accelerated. If, instead of the "start" button, the "inching" button be pressed, it has the effect of exciting the clapper switch and thereby closing the motor circuit, but it does not excite the accelerating solenoid, and the clapper switch will remain closed only so long as the pressure on the button is maintained.

The function of the "retarding" button is to slow down the motor. When pressure of the "retard" button ceases the motor will continue to run at the speed it had attained when the finger was removed from the button. A depression of the "stop" button will always, under any circumstances, cause the clapper switch to open and the accelerating solenoid to be de-energized, so that the motor circuit will be broken and the cross-head will fall to the bottom, reinserting the starting resistance ready for the next start.

This controller can also, if desired, be fitted with armature diverting resistance for the purpose of obtaining a speed lower than can possibly be obtained by means of series resistance.

Conduit-Box Receptacles with Adapter Cap

The General Electric Company of Schenectady, N. Y., has produced a "standard" conduit-box receptacle with adapter cap and steel strap for use with Sprague and Thomas & Betts small non-adjustable floor outlet boxes. These devices have been developed to provide current supply to portables of all kinds, fans, heating devices, etc., from an outlet in the floor. If the device is installed under a rug, a small opening is made

RECEPTACLE, ADAPTER, CAP AND STEEL STRAP COMPLETE

so that the stem of the adapter can be inserted. This stem is the only part of the device appearing above the surface of the rug. When used on power or heating circuits the rating is 10 amp., 250 volts. On lighting circuits the rating is N. E. C. S. standard.

Trade Notes

GEORGE B. NORTH has been appointed general sales manager of the Hazard Manufacturing Company of Wilkes-Barre, Pa. The offices will be at 533 Canal Street, New York City.

ROBERT W. ADAMS, manager of the Providence (R. I.) office of the General Electric Company, was elected president of the Providence Engineering Society at its recent annual meeting.

THE ROSS POWER EQUIPMENT COMPANY has been appointed Indianapolis representative of the Lincoln Electric Company of Cleveland, Ohio, with offices at 617 Merchants' Bank Building, Indianapolis, Ind.

CLINTON DOYERT, who has been representing the St. Louis branch house of the Western Electric Company in southeast Missouri, has been appointed sergeant major in the Sixth Missouri National Guard and is now in a training camp in that State.

SPERRY & BITTNER, Pittsburgh, Pa., is the name of a new firm that has opened offices in the First National Bank Building as manufacturers' agents. Ralph C. Sperry, one member of the firm, was formerly Pittsburgh district manager of the Brilliant Electric Division of the National Lamp Works. William A. Bittner, the other member, has for the last ten years been connected with the Union Electric Company of Pittsburgh as office manager and purchasing agent. Both are well known to the electrical fraternity. At present they represent the Steel City Electric Company of Pittsburgh, A. O. Schoonmaker Company of New York City and the Argus Lamp & Appliance Company of Cleveland, Ohio.

THE GEORGE CUTTER COMPANY, South Bend, Ind., announces the appointment of R. W. Ten Broeck and A. B. Sonneborn as sales representatives for the State of Michigan, with offices at 426 Ford Building, Detroit. In connection with the sale of street and industrial lighting equipment, switches, panelboards, switchboards, cut-out boxes and other products of the George Cutter Company, an engineering department will be maintained for the purpose of drawing up plans and specifications for the installation of such equipment. Mr. Ten Broeck was associated with the Packard Motor Company for a number of years, later with the Davis Slate & Manufacturing Company, and for the last two years with the Mutual Electric & Machine Company of Detroit. Mr. Sonneborn was connected with the latter company for three years and during the last year was district representative of the Detroit Electric Welder Company of Lansing, Mich., with offices in Detroit.

THE DIAMOND POWER SPECIALTY COMPANY has established at Detroit the first plant devoted exclusively to the production of "Insuluminum" soot-blower units. The process originated and was perfected in the laboratory of the General Electric Company, the latter company having granted to the Diamond Power Specialty Company the exclusive rights as lessee to its use. The essential point of difference between the effects of this process and any hitherto used commercially, such as galvanizing or sherardizing, is that the insulating material is not imposed as a coating upon the surface of the metal to be treated, but enters into intimate association with it, so that the whole outer region of the body affected changes its composition. A homogeneous alloy is formed, which cannot be destroyed except as the mass of which it is a part is destroyed. The richness of the alloy is proportional to the depth of impregnation, which varies with the length of time of the treatment.

THE WESTERN ELECTRIC COMPANY'S Kansas City branch, responding to the need for more energy on the farm, is planning an intensive campaign to present electric generating units and equipment to the farmers of several states. A meeting of salesmen in the farm-lighting department was held in Kansas City on Aug. 2 and 3, at which H. L. Harper, sales manager, outlined the program and drilled the men in the promotion of equipment suitable for farms. The campaign will be based on the practical demonstration of equipment to farmers and communities. Salesmen who are now covering territory by automobile, carrying small units in the backs of their cars, will be provided with trailers in which will be more elaborate equipment and samples of devices. The trailers and the items which will be furnished were shown and the ways of using them most effectively explained. Each trailer will carry a storage battery, a small gasoline engine, a generator, a switchboard, a long cord and sockets, and such devices as a fan, iron and similar pieces. The equipment will be demonstrated to the farmers and their wives in the farm homes, as heretofore. But with the trailer there will be the advantage that the entire outfit can be left at home for trial use, the salesman calling next day to get the order. One of the most important advantages of the trailer method has to do with selling to organizations and to leading business men in small towns. For instance, the trailer may be provided for a community meeting, the engine and generator being strong enough to provide ample light for a hall. Not only will the organization or the owner of the hall see the advantage of the equipment, but every person attending the meeting will have a practical demonstration.

Trade Publications

ELECTRIC RANGES. — The National Electric Utilities Corporation, 103 Park Avenue, New York City, is distributing a bulletin descriptive of its electric ranges.

TRUCKS. — "Driver Dan the Sterling Man" is the name of the new publication now being distributed by the Sterling Motor Truck Company of Milwaukee, Wis. This bulletin should be of interest to every user and driver of automobile trucks.

KNIFE SWITCHES.—The Leonard-Bundy Electric Company of Cleveland, Ohio, is distributing a bulletin descriptive of its safety-type knife switches, panelboards, cabinets, etc. It is also distributing a bulletin descriptive of knife switches only.

PORTABLE LIGHTING OUTFIT.—Bulletin No. 819, descriptive of the Edison electric portable lighting outfit, is being distributed by the Edison Storage Battery Company of Orange, N. J. This bulletin describes this outfit and explains the method of using it.

WASHING MACHINE.—The American Washing Machine Manufacturers' Association, 10 South La Salle Street, Chicago, has issued a booklet entitled "Who Washes Your Clothes?" It is the story of the washing machine for household use in both city and rural homes.

PNEUMATIC PAINTING EQUIPMENT. —The Spray Engineering Company, 93 Federal Street, Boston, Mass., has prepared a bulletin describing its Spraco pneumatic painting equipment. This is a further development of the Spraco paint gun which was recently developed.

USES FOR ELECTRIC FANS.—A bulletin descriptive of sales methods for the selling of electric fans is being distributed by the Society for Electrical Development, Inc., 29 West Thirty-ninth Street, New York City. This bulletin takes up the method of using electric fans for the drying of fruits and vegetables. It outlines a campaign for the selling of electric fans and the building up of the fan load.

THE SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.—"Aims and Achievements" is the title of a bulletin being distributed by the Society for Electrical Development, Inc., 29 West Twenty-ninth Street, New York City This is a brief summary of what the society is accomplishing for its members and for the entire electrical industry This bulletin describes just what this society is, how it has grown, what its work includes, its members, its officers, and committees.

SYNCHRONOUS MOTORS FOR POWER-FACTOR CORRECTION. — The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued an enlarged and up-to-date circular on the theory and application of synchronous motors for power-factor correction. The publication furnishes a clear and concise explanation of the underlying principles of power-factor correction and its control. A complete set of accurately plotted curves, accompanied by examples showing their application to cases in actual practice, are shown. These curves give the operating man and those unversed in technical calculation a simple graphical solution for all problems in power-factor correction likely to arise in ordinary practice. Illustrations and detail description show standard Westinghouse machines for capacities from 200 kva. to 15,000 kva. and for all commercial voltages from 220 to 6600 volts. Exact operating figures, furnished in several cases by members of operating staffs of the companies concerned, show the success of synchronous motors in improving operating conditions.

New Incorporations

THE ELECTRIC LABORATORIES of Fresno, Cal., has been incorporated with a capital stock of $10,000 by D. K. Cawker, L. L. Davenport and C. E. Davenport.

THE SORGEL ELECTRIC COMPANY of Milwaukee, Wis., has been incorporated with a capital stock of $25,000 by W. R. Sorgel, Frank L. Fawcett and Paul R. Newcomb.

THE PAUL M. EVANS COMPANY of Philadelphia, Pa., has been chartered with a capital stock of $25,000 to manufacture electric storage batteries. S. H. Evans is treasurer.

THE REUSCH ELECTRIC COMPANY of Lincoln, Neb., has been chartered with a capital stock of $5,000. Orvis B. Dresbach is president and Herman Reusch is secretary and treasurer.

THE LA FRENCH POWER SPARK PLUG COMPANY of Dayton, Ohio, has been chartered with a capital stock of $100,000 to manufacture spark plugs by F. A. Eastman and others.

THE UNIT VENTILATION COMPANY of Queens, N. Y., has been incorporated by A. Bautz, Jr., of College Point; W. F. Brown, 911 Whitlock Avenue, the Bronx, and J. F. Maguire, 375 Fulton Street, Brooklyn, N. Y.

JOHN N. BOWMAN of New York, N. Y., has filed articles of incorporation with a capital stock of $500 to deal in electrical material and devices. The incorporators are: John N. Bowman, M. C. Bowman and Charles F. Klaus.

THE AMERICAN LAMP COMPANY of Dover, Del., has been incorporated by Joseph E. and Harold B. Parker and Everett P. and Harold F. Collins. The company proposes to manufacture electric-lighting fixtures.

ENGHOLM & PARTNERS of Toronto, Ont., have filed articles of incorporation with a capital stock of $100,000, to do a general structural, civil and mechanical engineering business, and to construct hydraulic and electric plants.

THE BAY STATE INSULATED WIRE & CABLE COMPANY of Boston, Mass., has been chartered with a capital stock of $300,000. The directors are: John H. H. McNamee, president and treasurer; Daniel T. O'Connell and M. J. Cashman.

THE PUBLIC LIGHT SERVICE COMPANY of Bayonne, N. J., has been chartered with a capital stock of $25,000 to manufacture lighting fixtures. The incorporators are: Edward Sweeney, Louis Lehr and Murray Bell of Bayonne, N. J.

THE FLASHLIGHT & ELECTRICAL MANUFACTURING COMPANY of Cleveland, Ohio, has been incorporated with a capital stock of $15,000 by Richard E. Murphy, Louis J. Rieske, Ernest J. Hileman, L. L. Rood and William C. Schaefer.

THE GENERAL RADIO CORPORATION of New York, N. Y., has been chartered by E. F. Chandler, D. Westreich and J. M. Kornfield, 206 Broadway, New York, N. Y. The company is capitalized at $20,000 and proposes to manufacture special radio apparatus.

THE ABELL-HOWE COMPANY of Wilmington, Del., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $50,000 and proposes to manufacture electrical and mechanical specialties. The incorporators are C. M. Ringlinger and Henry M. Robinson of Wilmington, Del., and Clement M. Egner of Elkton, Md.

THE BOUND BROOK ENGINE & MANUFACTURING COMPANY of Philadelphia, Pa., has been incorporated by Wray C. Arnold, Root C. Finder and H. Foldenden of Philadelphia. The company is capitalized at $300,000 and proposes to manufacture engines, electrical apparatus, etc.

THE NEW HAVEN RIVET COMPANY of New Haven, Conn., has been incorporated with a capital stock of $5,000 to manufacture hardware and electrical supplies. Henry C. Smith is president and Frank S. Day is secretary and treasurer.

THE STRINGSON FIRE SIGNAL COMPANY of New York, N. Y., has been chartered by H. Strongson, R. W. Thompson and H. R. Sanford, 6 East Thirty-sixth Street. The company is capitalized at $20,000 to manufacture fire alarm equipment.

THE GIRTANNER MANUFACTURING & SALES COMPANY of St. Louis, Mo., has been incorporated by Fred Girtanner, Herman Mueller and L. L. Kraft. The company is capitalized at $20,000 and proposes to manufacture house supplies and accessory equipment.

New England States

PORTLAND, ME.—New construction and repair work being done by the Cumberland County Power & Light Company in Portland will involve an expenditure of more than $60,000 and will include relaying tracks, placing overhead wires underground, conduits now being built for that purpose.

SQUIRREL ISLAND, ME.—The installation of an electric-lighting system at Squirrel Island is under consideration. The cost of installing a plant is estimated at $15,000.

BOSTON, MASS.—The Revere Rubber Company is planning to erect a new transformer house, 20 ft. by 60 ft., at its plant on Eastern Avenue, to cost about $10,000.

CHICOPEE, MASS.—Bids will be received at the office of the Electric Light Department, Front Street, Chicopee, until Aug. 21, for the erection of a garage and storehouse. Plans and specifications may be obtained at the above office upon deposit of $25.

CLINTON, MASS.—The Metropolitan Water and Sewerage Board has awarded a contract for the erection of the 16-mile electric transmission line from the Wachusett dam in Clinton to the dam at the Sudbury Basin in Southboro to the F. T. Ley Construction Company of Springfield at $74,477.

PITTSFIELD, MASS.—The Barrett Company is contemplating erecting an extension to its local power plant. The main offices of the company are located at 35 Wendell Street, Boston, Mass.

SPRINGFIELD, MASS. — The United Electric Light Company has purchased the property of the United Button Company on both sides of Olive Street, consisting of six buildings and land, 360 ft. by 160 ft., to be used in connection with its proposed extensions. The Button company will occupy the premises for the present.

PROVIDENCE, R. I.—The stockholders of the Narragansett Electric Lighting Company have voted to increase the capital stock of the company by $1,700,000.

HARTFORD, CONN.—The Hartford Electric Light Company has purchased a site, embracing nearly 95 acres in the "South Meadows," on which it will erect a power house at some future time.

NEW HAVEN, CONN.—Work has begun on the extension of the ornamental lighting system in Elm, George, Orange and Church Streets. Later on the lamps will be extended down Meadow Street. Application has been made for an appropriation to extend the ornamental lighting system down Grand Avenue to the railroad crossing.

NEW HAVEN, CONN.—Preparations are being made by the Connecticut Light & Power Company, which has taken over the properties of the Rocky River Power Company, the Housatonic Power Company of New Haven, the United Electric Light & Power Company of Waterbury and the Seymour (Conn.) Electric Light Company, for the development of an 18,000-kw. hydroelectric plant at a site known as Stevenson on the Housatonic River. The company, it is reported, has also purchased a site, placed orders for equipment and material, and will soon begin work on the construction of an additional steam generating power station at tidewater, which, it is understood will have an ultimate capacity of 100,000 kw. The plans provide for an initial installation of 20,000 kw. The estimated total capacity of the undeveloped water rights acquired by the consolidation on the Housatonic and Rocky Rivers is approximately 75,000 kw., including the Stevenson site, which is now being developed.

NEW LONDON, CONN.—Extensive improvements are being made to the power system of the Housatonic and Middletown divisions of the Connecticut Power Company. The 66,000-volt transmission line which connects the hydroelectric plant at Falls Village with Torrington, Thomaston, Bristol and Hartford will be extended from near Beckley Station to a 3000-kw. transformer station which will be erected in Cromwell on the company's property near the river front; from the Cromwell station a 13,200-volt transmission line is being erected to connect with the company's power station in Middletown. This connection will be made through another 3000-kw. substation, located adjacent to the present power plant. Equipment for the extension to the Van Dyke substation, as well as the present connection between the substation and the Dutch Point power station of the Hartford Electric Company, will be duplicated so as to double the present capacity of the system. Improvements are also being made to the systems at Falls Village, Torrington, Thomaston and Bristol, consisting of the installation of electrolytic lightning arresters, etc. The Stone & Webster Engineering Corporation of Boston, Mass., has charge of the engineering work.

WATERBURY, CONN.—The contract for an addition, 61 ft. by 97 ft., to the power plant of the Housatonic Power Company on West Main Street has been awarded to Tracy Brothers Company.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 21, for furnishing range finders and transmission systems and wire and cable, etc., at the Brooklyn Navy Yard. Proposal blanks may be obtained on application to the above bureau or to the supply officer, Navy Yard, Brooklyn.

BUFFALO, N. Y.—The Sizer Forge Company is erecting an electric furnace building, a steel and brick coal house and a covered scrap-iron yard, to cost, with equipment, $110,000, at its plant at Larkin Street and Erie and Lake Shore Railroads.

BUFFALO, N. Y.—Contract has been awarded by the International Railway Company, it is reported, for the construction of a substation, 75 ft. by 90 ft., to be erected at North Division and Oak streets.

BUFFALO, N. Y.—The Pullman Company, 1770 Broadway, has begun work on the construction of a new carshop, 235 ft. by 540 ft., one story, at its local works, to cost about $175,000. A new power house and electric power plant, 60 ft. by 110 ft., will also be built.

BUFFALO, N. Y.—The stockholders of the Buffalo General Electric Company have voted to authorize an issue of $4,000,000 in bonds, the proceeds to be used to finance extensions, including additional construction at the steam generating plant outside of Buffalo.

ELLISBURG, N. Y.—Application has been made to the Public Service Commission by Harlow E. Ralph for authority to erect a new electric transmission line between Henderson and Ellisburg.

FLUSHING, N. Y.—The New York & Queens Electric Light & Power Company contemplates the construction of a new two-story substation, to cost about $50,000, on Lawrence Avenue, Flushing.

MONROE, N. Y.—The Orange & Rockland Electric Company has applied to the Public Service Commission for permission to issue $180,000 in capital stock, the proceeds to be used to pay for new construction, including transmission lines.

NEW HAMPTON, N. Y.—Bids will be received by the Commissioners of Correction, Municipal Building, New York, until Aug. 30 for construction of power house, tunnels and chimney at New Hampton.

NEW YORK, N. Y.—The New York Edison Company has awarded a contract for the construction of a one-story extension to its substation on West Twenty-seventh Street, to cost about $35,000.

NEW YORK, N. Y.—Bids will be received at the United States Immigration Station, Ellis Island, N. Y., until Aug. 20, for alterations and new boilers for the power house at the United States Immigration Station, Ellis Island. For further information apply to United States Commissioner of Immigration, Ellis Island.

SHERMAN, N. Y.—The Public Service Commission has given the borough officials permission to establish and operate a municipal electric-light plant in Sherman.

SYRACUSE, N. Y.—The City Council has approved an issue of $13,000 in bonds for the purchase of new boilers and auxiliary equipment for the city hall plant.

CALDWELL, N. J.—The lowest bid for electrical work at the penitentiary at Caldwell was submitted by the Beaver Engineering Company, 59 Mechanic Street, at $3,474.

DOVER, N. J.—The New Jersey Power & Light Company has completed a new 11,000-volt transmission line from its power station at Mount Arlington to the Stanhope-Netcong district, a distance of about 5 miles. The new line will supply energy for distribution by the local company in Stanhope and Netcong for lamps and motors.

ESSEX FELLS, N. J.—Bids will be received by the committee on street lighting until Aug. 24 for lighting the streets with 32-cp. lamps for a period of five years from Sept. 1, 1917.

FLEMINGTON, N. J.—The property of the Flemington Electric Light, Heat & Power Company is reported to have been purchased by the Lambertville (N. J.) Public Service Company. Arrangements are being made to extend the transmission lines to connect the Lambertville and Flemington systems.

MADISON, N. J.—The Borough Council has extended the time for the municipal electric-light plant to discontinue service to non-resident subscribers until Sept. 1, in accordance with the ruling of the Board of Public Utility Commissioners prohibiting the sale of power generated by municipal plants outside of the borough limits.

MOUNT HOLLY, N. J.—The Public Service Electric Company has been awarded contract for lighting the new army cantonment at Wrightstown. Service will be supplied from the power station at Burlington. A new transmission line will be erected from Burlington to Mount Holly and thence to Wrightstown, about 20 miles. A new substation will be erected at the camp.

NEWARK, N. J.—The Murphy Varnish Company is planning to build a new boiler house at its plant on Beecher Street, to cost about $8,000.

NEWARK, N. J.—The lowest bids for the installation of a new lighting system at the Center Market was submitted by the Jennings Fixture Company.

NEWARK, N. J.—Bids will be received by the board of education, Essex Building, Newark, until Aug. 22 for one motor-generator set, with panels and auxiliary apparatus, and electrical equipment for shop lighting for the County Vocational Schools. Wesley A. O'Leary is director.

PITMAN, N. J.—The borough officials have entered into a new contract with the Electric Company of New Jersey for a period of five years, under the terms of which the company is to furnish not less than 123 modern street lamps of 80 cp.

EASTON, PA. — The Taylor-Wharton Iron & Steel Company has entered into a five-year contract with the Pennsylvania Utilities Company of Easton for furnishing energy to operate its furnaces and other plant equipment.

LANCASTER, PA.—The contract for electric wiring, telephone, fire-alarm and clock systems at the new Boys' High School building has been awarded to the Lancaster Supply & Construction Company, at $9,287.

MARCUS HOOK, PA.—Contract has been awarded by the Benzol Products Company to F. W. Van Loon, 4 North Eleventh Street, Philadelphia, for the construction of a new main switch and transformer station at its plant, to cost about $10,000.

PENNSBURG, PA.—The Perkiomen Paper Company is contemplating the construction of an addition to the boiler house at its plant.

PHILADELPHIA, PA.—The Thomas Potter's Sons Company is planning to build an addition to its engine house on Second Street.

PHILADELPHIA, PA.—The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, manufacturers of electrical specialties, has awarded a contract to John L. Gill & Company, Otis Building, Philadelphia, for the construction of an addition, three stories, to its plant.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 27, for heating system for machine and electric shop, at the navy yard, Philadelphia, Pa. Drawings and specifications (No. 2500) may be obtained on application to the bureau or the commandant of the navy yard named.

PITTSBURGH, PA.—Plans are being prepared by the Pittsburgh Products Company, Frick Annex, Pittsburgh, for the erection of a large seamless-tube plant at Allenport, opposite Fayette City. The company, it is understood, will soon purchase an extensive line of equipment, including cranes, shears and seamless-tube machinery.

TEMPLE, PA.—The new plant of the Temple Malleable Iron & Steel Company, it is reported, will consist of a one-story malleable foundry, 136 ft. by 288 ft.; hard-iron mill, 32 ft. by 170 ft.; soft-iron mill and annealing works, 95 ft. by 260 ft.; one-story pattern shop, 36 ft. by 90 ft.; core house, 50 ft. by 70 ft., and power house, 65 ft. by 80 ft. The cost of the buildings, with equipment complete, is estimated at $500,000. Frank D. Case, People's Gas Building, Chicago, Ill., is architect.

WEST CHESTER, PA. — Work has started on the construction of an addition to the power house of the West Chester Street Railway in Lenape. The new build-

ing will be equipped with a large transformer, which will be used in connection with the new high-tension system connecting all three of the electric power plants of the company at Lenape, Downington and Coatesville.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company is reported to be extending its electric transmission lines from Brooklyn to Glenburnie along the Brooklyn Boulevard.

BALTIMORE, MD.—Bids, it is reported, are being asked by the Consolidated Gas, Electric Light & Power Company for construction of its proposed new power house at Westport. The company is also erecting an addition to its engine house, No. 2, Spring Gardens, to cost about $20,000.

MARLINTON, W. VA.—At an election held recently the proposal to issue $20,000 in bonds to purchase the local electric-light plant and water-works system was carried.

MARTINSBURG, W. VA.—Plans are being considered by the Berkeley Woolen Mills for the construction of a new central power plant for its Raleigh Street works.

SOUTH CHARLESTON, W. VA.—The E. C. Klipstein & Sons Company, 644 Greenwich Street, New York, N. Y., manufacturers of chemicals, etc., has awarded contract for electric motors for buildings No. 5 to No. 11 inclusive to the Lincoln Electric Company of Cleveland, Ohio.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Sept. 3, for construction of two wood-frame quarters; one receiving building and one power house, complete with electric lighting, plumbing, etc., for all four buildings at the high-power radio station, El Cayey, P. R. Drawings and specifications (No. 2389) can be obtained on application to the bureau or to the commandant of the navy yard, New York, N. Y.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Charleston, W. Va., Schedule 1395—one 15-ton locomotive crane. Mare Island, Cal., Schedule 1396—one motor-driven radial drill. Key West, Fla., Schedule 1404—one back-geared engine lathe, one horizontal 66-in. boring and drilling machine, one 200-ton forging, hydraulic press. Fort Mifflin, Pa., Schedule 1400—one motor-driven turret 24-in. lathe, one motor-driven engine lathe. Norfolk, Va., Schedule 1397—One motor-driven centrifugal pump.

North Central States

JACKSON, MICH.—Bids will be received at the office of A. W. D. Hall, city manager, Jackson, Mich., until Aug. 29, for furnishing and installing one steam-driven vertical, centrifugal pump and one or more electrically driven deep-well horizontal pumps for the municipal water-works system. Plans and specifications may be obtained at the office of the superintendent of water works, Jackson, or at the office of Seabury G. Pollard, consulting engineer, 3422 Burch Avenue, Cincinnati, Ohio.

STURGIS, MICH.—The village of Sturgis has awarded the contract for the excavation of tailrace for a power plant on the St. Joseph River, 3 miles from Centerville, to the G. W. Bunker Company. The channel will be from 50 to 75 ft. wide and 15 ft. deep.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Aug. 24 for construction of brick tunnel and concrete foundations for the division of light and heat. Specifications may be obtained by applying to the above office.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Aug. 24 for furnishing motor truck or tractor and trailer equipment for the division of city hospital, Department of Public Welfare. Specifications may be obtained upon application to the office of the director of public welfare, Room 327, City Hall.

LUCASVILLE, OHIO.—Preparations are being made to establish a municipal electric-light plant in Lucasville. Alonzo Purdy is chairman of a committee appointed to purchase the machinery.

SANDUSKY, OHIO.—Plans have been prepared by George Feick & Company, architects, for a telephone exchange building to cost about $35,000 for the Sandusky Telephone Company.

YOUNGSTOWN, OHIO.—The Mahoning & Shenango Railway & Light Company has closed a contract with the National Sand & Stone Company in the Mineral Ridge district. About 125 hp. will be required. The National company will discard its steam plant.

HAZARD, KY.—The Kentucky Power Company is reported to be considering extending its electric transmission lines into the Letcher County coal-mining field to supply electricity for mining operations there.

SERGENT, KY.—Plans are being considered by the Whitley-Elkhorn Coal Company for the installation of a new electric generator and auxiliary equipment and electrically operated coal-handling machinery at its local properties.

SOUTH PORTSMOUTH, KY.—Bids will be received at the United States Engineer Office, Cincinnati, Ohio, until Aug. 31, for construction of power house at dam No. 31, Ohio River. Further information may be obtained on application to the above office.

FORT WAYNE, IND.—The Fort Wayne & Indiana Traction Company, it is reported, is considering building an addition to its Spy Run power house, to cost about $35,000.

BLOOMINGTON, ILL.—An estimate submitted to the City Council for the installation of a municipal electric-light and power plant by C. C. Williams, superintendent of the municipal water and light plant, places the cost at $382,625. It is not expected that any definite steps will be taken to install a plant at this time.

JOLIET, ILL.—Owing to the change in the voltage in energy from 2300 to 12,000 volts taken from the new steam plant of the Public Service Company at Joliet, the Chicago & Joliet Electric Railway Company is installing transformers and lightning protection for this service in Joliet. An underground cable connection between the railway substation and new substation of the Public Service Company, now under construction, will also be provided.

ROCKFORD, ILL.—The City Council has granted the Central Union Telephone Company permission to lay conduits in a number of streets, including West State Street from Avon to Independence Avenue.

THOMSON, ILL.—Bids will be received at the office of Franklin J. Stransky, attorney of the Savanna and York drainage district, Savanna, until Sept. 6, for pumping station and appurtenances, etc., as follows: (a) For furnishing material, machinery and construction of pumping station; (b) furnishing and installing pumping machinery, electrical apparatus and auxiliaries. Alternative bids will be received on an oil engine-driven or a steam-driven plant. Plans and specifications may be obtained from the Edmund T. Perkins Engineering Company, First National Bank Building, Chicago, Ill., and Illinois State Bank Building, Quincy, Ill., and from N. D. French, secretary, Thomson, upon deposit of $10.

MILWAUKEE, WIS.—The Wisconsin Engine & Dynamo Company of Milwaukee, recently incorporated with a capital stock of $200,000, it is reported, will soon erect or lease a plant in Milwaukee or suburbs, for which equipment, it is said, is now being purchased. John I. Beggs, of Milwaukee, is reported interested in the company.

DES MOINES, IOWA.—The property owners on Sixth Avenue are considering presenting a petition to the City Council asking for the installation of the electrolier lighting system on Sixth Avenue as far north as School Street.

DUBUQUE, IOWA.—The Eastern Iowa Electric Company has petitioned the Board of Supervisors for a franchise to erect electric transmission lines from Dubuque to Dyersville, New Wine, Luxemburg and Holy Cross.

McGREGOR, IOWA.—The plant and holdings of the McGregor Electric Light & Power Company are reported to have been purchased by the Mid-Continental Utilities Company of Chicago, Ill. The plants in Lancaster, Boscobel, Fennimore and Platteville, Wis., have also been taken over by the Mid-Continental company.

MANCHESTER, IOWA.—The purchase of the local electric plant of the Iowa Electric Company, to be owned and operated by the municipality, is under consideration by the City Council.

KANSAS CITY, MO.—Bids will be received by the purchasing agent of Kansas City, second floor, City Hall, until Sept. 12, for designing, construction and installing a steam turbine, reduction gear, centrifugal pumping unit having a capacity to pump 20,000,000 U. S. gallons per 24 hours, against a total combined head of 370 ft. and a steam pressure of 165 lb. per sq. in. at throttle, together with machinery, tools and appurtenances necessary, in accordance with plans and specifications on file in the office of the chief engineer of the water department. W. C. Weaver is purchasing agent and Burton Lowther is chief engineer and superintendent.

WARRENSBURG, MO.—The new street-lighting contract with the Warrensburg Light & Power Company has been ratified by the City Council. The new contract is for a period of five years and provides for the installation of an ornamental lighting system in the business section and the erection of 140 lamps in the residential districts.

ELLENDALE, N. D.—The Ellendale Electric Company is installing a 150-kw. generator directly connected to a 200-hp. Skinner uniflow engine. The company is also installing a complete steam heating plant, at a cost of about $12,000. G. F. Phillips is manager.

WILTON, N. D.—The Washburn Lignite Coal Company contemplates changing its lighting system from direct to alternating-current system next year. W. P. Macomber is manager.

LINCOLN, NEB.—Bids will be received by the Board of Regents, Lincoln, until Sept. 1 for construction of a social science building. Separate bids to be submitted on heating, ventilating, vacuum cleaner, electric wiring, etc. The building will be 160 ft. by 220 ft., three stories and basement, and will cost about $300,000. Proposals to be addressed to J. S. Dales, secretary board of regents, Station A, Lincoln.

LOOMIS, NEB.—The Intermountain Railway, Light & Power Company of Holdredge has decided to postpone erecting an electric service line from Holdredge to Loomis until national financial affairs are in a more settled condition. The issue of bonds, authorized at the spring election, and the village lighting and interest tax levies will be held in abeyance until work on the line is started.

WESTERN, NEB.—The installation of an electric-lighting system in Western is under consideration.

GOODLAND, KAN.—The Goodland Light & Power Company is installing a 125-hp. Muncie crude oil engine in its power plant.

LARNED, KAN.—Steps have been taken to organize a company to erect an electric transmission line between Larned and Garfield. The cost of the line is estimated between $6,000 and $7,000.

MILTONVALE, KAN.—The City Council is considering the disposal of the municipal electric-light plant to the Riverside Electric Light, Power & Gas Company of Abilene.

ROSSVILLE, KAN.—The local electric-light plant, owned by the R. B. Feagan Electric Company of Junction City, is reported to have been purchased by a syndicate of Colorado capitalists.

Southern States

CHARLOTTE, N. C.—The contract for electrical equipment for Camp Greene has been awarded to Tucker & Laxton of Charlotte. The cost of the work is estimated at about $200,000, and it will require 2,000,000 lin. ft. insulated wire, 15,000 lamps, etc.

ORIENTAL, N. C.—The Town Council is considering issuing bonds for the installation of a municipal electric-light plant.

CHARLESTON, S. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 25, for construction of one shell house, one torpedo storehouse and one magazine building, including electrical work, etc. Drawings and specifications (No. 2488) may be obtained upon application to the above bureau or to the commandant of the navy yard, Charleston.

ATLANTA, GA.—The Georgia Railway & Power Company is planning to extend its line to Camp Gordon, near Chamblee, a distance of about 5 miles.

ST. CLOUD, FLA.—The City Council is considering taking over the local electric-light plant and distributing system to be owned and operated by the municipality.

MEMPHIS, TENN.—The Memphis Consolidated Gas & Electric Company and the Merchant Power Company have been consolidated under the name of the Memphis Gas & Electric Company.

ANNISTON, ALA.—The Alabama Power Company is contemplating the erection of a transmission line to Camp McClellan.

FLORENCE, ALA.—The Muscle Shoals Traction Company, it is reported, has awarded a contract to the Central Construction Company of Indianapolis, Ind., for the construction of an electric railway between Florence and Huntsville, a distance of 64 miles, with branch to Lexington, 12 miles long. E. M. Wilkens is chief engineer, and M. S. Bingham is consulting engineer. Tracey W. Pratt of Huntsville is vice-president and treasurer of the Muscle Shoals Traction Company.

FAYETTE, MISS.—The old machinery in

the municipal electric-light and power plant has been removed to temporary quarters preparatory to installing the new oil engine and other equipment for which $17,000 in bonds was issued in June.

CLARKSVILLE, ARK.—The City Council has awarded the contract for the installation of an ornamental lighting system on Main Street, from the High School to the iron bridge, to the Wesco Supply Company of St. Louis, Mo.

FORT SMITH, ARK.—The erection of a new power house to cost about $250,000, either on site of present power station on Arkansas River front or on Poteau River in Le Flore County, is under consideration by the Fort Smith Light & Traction Company. The present plans provide for a plant of 5000 hp. capacity; the present plant has an output of 4200 hp., which it is proposed to enlarge and improve so that the two plants will have a generating capacity of 10,000 hp. An electric transmission line will be erected to Alma to supply energy to the Citizens' Electric Company, which has franchises in Alma, Mulberry and Ozark, and also to erect a 33,000-volt transmission line to Greenwood to furnish power to the Coal District Power Company to operate the coal mines in that district.

TEXARKANA, ARK.—The Four States Lumber Company is contemplating the purchase of boilers and other power plant equipment.

DUNCAN, OKLA.—An election will be held Aug. 21 to vote on the proposal to issue $45,000 in bonds for the installation of a municipal electric-light plant.

ERICK, OKLA.—Bonds to the amount of $25,000 have been authorized for the installation of a municipal electric-light plant.

FREDERICK, OKLA.—The city of Frederick is contemplating installing a 250-hp. steam engine, non-condensing, and one centrifugal pump, two-stage, directly connected to motor, maximum capacity 20,000 gal. per hour against a 16-ft. lift and a 65-lb. head. One pump of same capacity, either steam plunger or turbine type, to be used as an emergency.

LAWTON, OKLA.—Franchises have been granted to John C. Keys of Lawton to supply both electricity and gas in the towns of Lawton and Temple. The company now operating an electric franchise in Lawton will erect an electric transmission line from here to Temple. It is proposed to build a pipe line from the natural gas field, 19 miles from Lawton, to both towns at once.

NEWKIRK, OKLA.—The electric plant of the Newkirk Electric Light Company, recently destroyed by a tornado, will be rebulit.

OKLAHOMA CITY, OKLA.—The Oklahoma Gas & Electric Company, it is reported, has recently acquired the electric plants and systems in Norman, Yukon, Drumwright, Kiefer and Hennessey. Electric transmission lines are being erected to these and other communities.

PAWHUSKA, OKLA.—The purchase of equipment for oil-pumping plants is reported to be under consideration.

TEMPLE, OKLA.—At an election held recently the proposal to grant a franchise to John C. Keyes of Lawton to supply electricity and gas in Temple was carried. The municipal electric plant will be closed down. Energy to operate the local system will be transmitted from Lawton.

WOODWARD, OKLA.—The City Council has decided to call an election to submit the proposal to issue $42,000 in bonds for the installation of a municipal electric-light plant.

DENTON, TEX.—The Board of Regents has awarded contract for electrical work in connection with the erection of girls' dormitory, dairy barn and additions to laundry and power plants to the M. Lewin Electric Company of Dallas. The cost of the entire work is estimated at about $100,000.

TERRELL, TEX.—The property of the Terrell Electric Light Company, including the electric transmission line from Terrell to Forney, is reported to have been purchased by Fred M. Leight, Jr., of Galveston, and associates. The plant, it is understood, will be rebuilt and new machinery installed.

Pacific and Mountain States

ARLINGTON, WASH.—The Washington Coast Utilities Company is preparing to install a complete meter system in Arlington for furnishing electricity for both lamps and motors. The present flat-rate system will be discarded.

HOQUIAM, WASH.—The City Commission is negotiating with the Grays Harbor Railway & Light Company of Aberdeen and the North Pacific Public Service Company of Bremerton for lighting the streets of the city. Both companies submitted bids for lighting the city.

NORTHPORT, WASH.—The Northport Power & Light Company, recently organized with a capital stock of $200,000, to install an electric-light and power system in Northport, will purchase energy from the West Kootenai Power & Light Company of Rossland, B. C., connecting with its transmission lines at the boundary. The line will be erected from Bonnington Falls to Northport, a distance of 30 miles. The Northport power company will supply energy to the Northport Smelting & Refining Company. The Northport smelter, it is understood, will be operated by electricity instead of steam power. The cost of the electric system is estimated at from $125,000 to $150,000.

SEATTLE, WASH.—The city purchasing agent has been authorized to call for bids for meters for the light department for 1917 and 1918. About 4000 will be required.

SEATTLE, WASH.—The finance and city utility committees of the City Council are considering engaging J. L. Stannard of Portland, Ore., consulting engineer, to prepare an estimate and report of the power possibilities of Cedar River, between the existing power plant at Cedar Falls and the water-works intake at Landsburg.

TACOMA, WASH.—The City Commissioners have authorized a survey of the Mineral Lake power site. The city is considering the purchase of the power site with a view of developing the same as an auxiliary to the Nisqually plant. The proposed development would cost about $500,000.

TACOMA, WASH.—The city of Seattle has taken a 60-day option on the Lake Cushman power site, the purchase of which has been under consideration by the City Council at various times. The option taken puts the city under no obligation to purchase and requires no deposit. The site is owned by the Mason County Power Company and is valued at $400,000. The cost of development for a plant similar to the one at La Grand, with a 45-mile transmission line, is estimated at $5,000,000.

ALBANY, ORE.—The proposal to issue $250,000 in bonds for the purchase of the electric-light and power plant of the Oregon Power Company will be submitted to the voters at a special election to be held in December or at the general election in November, 1918.

HALFWAY, ORE.—The City Council has granted the Idaho Power Company of Boise a franchise to install and operate an electric-light and power system in Halfway for a period of 50 years.

HELIX, ORE.—The Town Council has signed a contract with the Pacific Light & Power Company of Portland for lighting the city for a period of five years. The Helix Milling Company will install a 100-hp. motor in its mill. A transmission line will be erected from Adams to Touchet, via Helix.

MARSHFIELD, ORE.—Preparations are being made to install new machinery at the shipbuilding plant of Kruse & Banks, including a large electric crane.

PORTLAND, ORE.—Work has been begun on the construction of a dam on the edge of Bull Run Lake to determine the possibility of storing water at the lake. It is proposed to increase the depth of the lake, thereby increasing the city water storage. The increase in the amount of water also may be a part of a municipal lighting plant project.

HANFORD, CAL.—The contract submitted by H. G. Lacey & Company for the installation of a new street-lighting system in the residential districts of the city has been approved by the City Trustees. The plans provide for the erection of 67 arc lamps.

LOS ANGELES, CAL.—Plans have been prepared by the Seventh Street Company, Union Oil Building, Los Angeles, for the construction of a reinforced concrete power house, 40 ft. by 90 ft., to be erected in the rear of 715 Olive Street, at a cost of about $14,000.

LOS ANGELES, CAL.—Final options have been secured on property on both sides of the Los Angeles River, where the Franklin Canyon siphon crosses this stream, which will be used for an auxiliary power plant for the municipal electric-lighting and power system. The proposed power station will have a capacity of 4000 hp. Contracts have been awarded for generators and other equipment. The cost is estimated at $125,000.

MARTINEZ, CAL.—Surveys have been completed by the Pacific Electric Metal Company for the erection of a large ferro-silicon factory near the depot at Bay Point. The plans provide for the erection of four or five concrete buildings. The electrical capacity of the plant will be about 10,000 kw.

RICHMOND, CAL.—The American Carbon Company has contracted with the Western States Gas & Electric Company for a large amount of electrical energy to operate its proposed plant to be erected in Richmond.

SAN DIEGO, CAL.—Arrangements are being made by the A. J. Savage Munitions Company for the erection of its proposed firearms plant. Plans for the initial structures provide for the erection of two one-story buildings, each about 60 ft. by 300 ft., with woodworking plant, to cost about $45,000. The cost of the machinery and equipment, which provides for electrical operation in all departments, is estimated at $225,000.

SAN FRANCISCO, CAL.—Improvements are contemplated by the San Francisco-Oakland Terminal Railways to its system on Telegraph Avenue, from Broadway to Fortieth Street and College Avenue, and on College Avenue, from Broadway to the Berkeley line, at a cost of about $143,000.

SAN JOSE, CAL.—Work will soon begin by the Peninsular Railway Company on the construction of an extension to the army cantonment at Palo Alto.

TRACY, CAL.—The directors of the West Side Irrigation District have awarded a contract to the General Electric & Machine Company of Stockton for completing power installation and furnishing seven complete pumping units, at about $60,000.

IDAHO FALLS, IDAHO.—The Utah Power & Light Company is reconstructing three 225-kva. units in its local plant. Work will soon begin on the erection of a 11,000-volt electric transmission line (1 miles long) to serve electricity for domestic and irrigation purposes in the Fairview district.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company is contemplating the construction of a large steam heating plant in Salt Lake City, to cost several hundred thousand dollars. The company already operates three steam plants in the city.

Canada

ANYOX, B. C.—The Granby Consolidated Mining, Smelter & Power Company is contemplating increasing the output of its smelter from 2500 to 3000 tons daily. New equipment, including a furnace, two large converters and other apparatus, will be installed.

KAMLOOPS, B. C.—Improvements will be made to the power plant at the King Edward Sanitarium, including the erection of a new power house and extension to the electric plant, at a cost of about $5,000.

WINNIPEG, MAN.—Tenders addressed to the chairman of the Board of Control will be received at the office of M. Petersen, secretary of board of control, Winnipeg, until Aug. 24 for furnishing and installing one mechanical chain-grate stoker for the municipal hospital power house on Morley Avenue. Specifications may be obtained at the office of W. P. Brereton, city engineer, 223 James Avenue.

EUGENIA, ONT.—Contract for the installation of a 4000-hp. generator and turbine at the Eugenia plant has been awarded by the Hydro-Electric Power Commission of Ontario. This additional unit will double the output of the plant.

GALT, ONT.—Plans for the erection of a hydroelectric station have been presented to the Hydro-Electric Power Commission of Ontario for approval. Bids will be asked for construction of the plant as soon as plans are approved.

HALDIMAND, ONT.—The residents of Haldimand and Crafton Townships have applied to the Hydro-Electric Power Commission of Ontario for electrical service. The petition has been presented by the Township Council of Haldimand.

Miscellaneous

CIENFUEGOS, CUBA.—The Cienfuegos, Palmira & Cruces Electric Railway & Power Company, it is reported, contemplates extending its system from Palmira to Cruces, a distance of about 10 miles.

MELBOURNE, VICTORIA, AUSTRALIA.—Tenders will be received by the director of navy contracts, Navy Office, Melbourne, Australia, until Oct. 24, for furnishing auxiliary machinery for the Flinders naval base, via Melbourne, including two electrically-driven air pumps, with complete set of spare parts; one steam-driven air pump, with complete set of spare parts;

two small circulating pumps; one large circulating pump; one large feed pump; one large feed pump, with complete set of spare parts; one small feed pump with complete set of spare parts, and one oil fuel pump with complete spare pumps. Tenders, forms and specifications are on file at Department of Trade and Commerce, Ottawa, Ont. Applications for information should refer to file No. A-1901.

SYDNEY, N. S. W., AUSTRALIA.—Tenders will be received by the director of naval contracts, care Commonwealth Navy Dockyard, Cockatoo Island, Sydney, N. S. W., Australia, until Oct. 10, for furnishing pumping plant and equipment for the Commonwealth naval dock yard, Cockatoo Island, including two main dock pumps with vertical spindle motors and control equipment; one vertical spindle motor and control equipment, four sluice valves, with four motors and control equipment; two drainage pumps with motors and control equipment; two exhaust pumps with motors and equipment; one enclosed motor and equipment for dock caisson. Tender forms, specifications and drawings are on file at the Department of Trade and Commerce, Ottawa, Ont. Applicants for information should refer to file No. A-1901.

Record of Electrical Patents

Notes on United States Patents issued on August 7, 1917

1,235,555. Inclosed Electric Fuse; Robert C. Cole, Hartford, Conn. App. filed July 23, 1916. Knife-blade terminal type.

1,235,579. Timing Device; Paul M. Lincoln, Pittsburgh, Pa. App. filed Sept. 2, 1914. Improvements.

1,235,584. System of Distribution; Friedrich W. Meyer, Wilkinsburg, Pa. App. filed Jan. 11, 1913. Improvement.

1,235,585. System of Distribution; Friedrich W. Meyer, Wilkinsburg, Pa. App. filed Jan. 11, 1913. Regulating and assisting the induction motors in their operation, and for compensating the power factors of the systems.

1,235,592. Device for Attaching Conductors to Insulators; Henri Parra, Port de Capdenac par Figeac, France. App. filed Nov. 17, 1913. Improvement.

1,235,607. Rectifying System; Edmund F. Sipher, Wilkinsburg, Pa. App. filed May 25, 1914. Employs a transformer wherein all portions of the secondary winding are active during each half cycle.

1,235,628. Lateral-Channel Induction Furnace; James R. Wyatt, Philadelphia, Pa. App. filed July 19, 1916. Stirs a pool by general horizontal scouring effect of a hot metal flow driven into the pool, preferably near its circumference, by motor effect and which may be introduced in a direction generally tangential thereto.

1,235,629. Electrical Induction Furnace; James R. Wyatt, Philadelphia, Pa. App. filed July 19, 1916. Provides electric melting appliances suitable for melting, refining or maintaining in molten condition metals having a relatively low melting point.

1,235,630. Multiphase Induction Furnace; James R. Wyatt, Philadelphia, Pa. App. filed July 19, 1916. Distributes a plurality of heating channels in new cooperative relation to a furnace pool.

1,235,638. Process for Obtaining Oxide of Titanium from Materials Incorporating Other Substances; Louis E. Barton, Niagara Falls, N. Y. App. filed March 30, 1917. New.

1,235,684. Electric Switch; Jay H. Hall, Cleveland, Ohio. App. filed March 18, 1913. Single magnet or winding which has the characteristic of maintaining its contacts open, not only when the winding is not energized, but also when it is energized above a certain value.

1,235,693. Knife Switch; Harry F. Johaningmyer, St. Louis, Mo. App. filed April 21, 1916. Improvement.

1,235,699. Vapor Electric Apparatus; Frederick G. Keyes, East Orange, N. J. App. filed Nov. 24, 1913. Proposes to substitute for the liquid anode an anode of tungsten or some other material capable of resisting the high temperatures to which the elements of the lamp are liable to be subjected.

1,235,724. Apparatus for the Electrolytic Production of Zinc, Copper or Other Metals; Marcel Perreur-Lloyd, Boulogne sur Seine, France. App. filed Dec. 14, 1915. Apparatus is composed of a rectangular vessel, preferably of slate, which contains the liquid electrolyte and the electrodes.

1,235,742. System of Constant-Current Distribution; Percy H. Thomas, Upper Montclair, N. J. App. filed Jan. 11, 1916. Provides for the neutralizing or overcoming or compensating for this characteristic of the mercury-vapor apparatus, which tends to disturb series operation.

1,235,761. Electric Air Heater; Carl O. Bergstrom, Boston, Mass. App. filed July 2, 1915. Portable.

1,235,796. Automatic Controlling Means for Electric Heaters; John E. Harvey, Milton, Mass. App. filed Dec. 16, 1915. Provides thermo-responsive means for opening and closing an electric circuit through the heating element.

1,235,803. Dynamo-Electric Machine; Edward B. Jacobson, Pittsfield, Mass. App. filed Dec. 3, 1913. Adapted to be used for charging a storage battery and also for starting a prime mover.

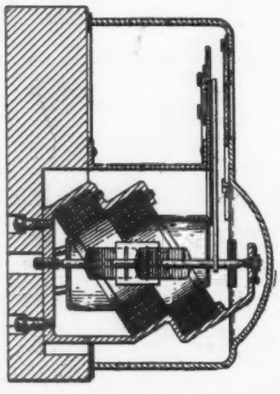
1,235,818. Electric Sign System; Malcolm E. Launbranch, Chicago, Ill. App. filed Jan. 22, 1916. Controls the selection of the lamps so that a predetermined word or sentence may be displayed upon the sign.

1,235,859. Automatic Electric Switch; Albert Thode, Hamburg, Germany. App. filed Oct. 21, 1913. Improvements.

1,235,905. Electrolytic Process of Making Alkali Perborates; Otto Liebknecht, Frankfort on the Main, Germany. App. filed Jan. 6, 1916. For the electrolytic production of sodium perborate by an electrolytic process.

1,235,926. Polyplex Terminal for Electric Light and Power Cables; George P. Roux, Philadelphia, Pa. App. filed Sept. 27, 1912. May be used as a junction box and branch tap.

1,235,932. Electric Control Apparatus; William M. Scott, Tredyffrin Township, Chester County, Pa. App. filed Feb. 14, 1916. Generator may be switched into circuit or in parallel with another generator or source of current only when the voltage of the incoming generator bears a certain relation to the voltage of the generator or source of current into whose circuit it is to be switched.



1,236,114—Electrical Measuring Instrument

1,235,978. Electrical Relay; Henry R. Holton, Chicago, Ill. App. filed Oct. 23, 1916. Employing a plurality of spring contacts engageable by a contact member, for closing a circuit through all of said contacts and to further provide an improved mounting for the said contacts.

1,235,996. Arc-Lamp Electrode; William R. Mott, Lakewood, Ohio. App. filed Sept. 25, 1914. Photographic use.

1,235,999. Repair Device for High-Voltage Electric Transmission Lines; George S. Neeley, St. Louis, Mo. App. filed April 30, 1915. Adapted to be utilized by workmen for replacing broken or damaged insulators which carry overhead electric conductors, and for effecting an immediate attachment of the line wires to the insulators, even though said wires be alive or charged with current.

1,236,001. Fuse Support; George S. Neeley, St. Louis County, Mo. App. filed May 22, 1916. High-tension distribution systems.

1,236,005. Electric Motor Control; Ernest W. Pittman, Flushing, N. Y. App. filed March 25, 1914. Applied to a planer.

1,236,025. Electrolytic Cell; Frank G. Wheeler, Appleton, Wis. App. filed Oct. 30, 1915. Diaphragm type.

1,236,026. Bushing for Electric Tubular Insulation; Carl M. Wheelock, Milwaukee, Wis. App. filed June 18, 1917. Means for securely attaching the tubing to the edges of openings such as those in cut-out boxes.

1,236,057. Separable Attachment Plug; Charles G. Cope, Chicago, Ill. App. filed April 5, 1913. Simplifies the construction.

1,236,066. Staybolt Testing Device; Ethan I. Dodds, Pittsburgh, Pa. App. filed July 25, 1916. Electromagnetic means which will operate promptly to detect a broken bolt.

1,236,082. Heating Device; Harry T. Hipwell and Harry H. Hipwell, Pittsburgh, Pa. App. filed July 20, 1916. For permitting the application of light rays to the human body.

1,236,090. Electric Riveting; Charles H. Kicklighter, Macon, Ga. App. filed Dec. 15, 1916. Provides an apparatus and method for heading rivets in cylinder seams by the use of polyphase currents.

1,236,091. Electric Welding; Charles H. Kicklighter, Macon, Ga. App. filed Dec. 15, 1916. For making a plurality of welds simultaneously by the use of polyphase currents.

1,236,114. Electrical Measuring Instrument; Robert Shand, Lynn, Mass. App. filed July 7, 1914. Duplex ammeter and voltmeter of the inclined-coil type.

1,236,128. Relay; Delavergne P. Williams and John F. Williams, New York, N. Y. App. filed Jan. 25, 1917. For setting up in one circuit electric impulses derived through another circuit.

1,236,130. Means for Measuring Electrical Energy; John C. Wilson, Milwaukee, Wis. App. filed Aug. 14, 1913. Provides compensating means which will enable wattmeters to give accurate readings under varying voltage conditions.

1,236,133. Electric Switch; Carl E. Anderson, Bridgeport, Conn. App. filed Sept. 1, 1916. Snap.

1,236,135. Electric Battery; Charles E. Avery, Trenton, N. J. App. filed Sept. 1, 1916. Dry.

1,236,161. Plug; David D. Gordon, Chicago, Ill. App. filed March 6, 1916. Separable attachment.

1,236,177. Relay; Ernest H. Jacobs, Schenectady, N. Y. App. filed Feb. 26, 1914. Time-limit relays.

1,236,188. Insulator; Edwin N. Lightfoot, New York, N. Y. App. filed Dec. 21, 1912. Improvements.

1,236,206. Supporting Means for Arc-Lamp Electrodes; John C. Ohnstad, Fort Monroe, Va. App. filed July 9, 1913. Electrodes are made to burn away evenly.

1,236,210. Attachment Plug; Paul D. Phillips, Chicago, Ill. App. filed May 12, 1913. Improves upon the construction of the threaded contacts.

1,236,248. Phonograph Attachment; Wilfred A. Atkinson, Phillipsburg, N. J. App. filed May 19, 1916. Automatic lighting.

1,236,302. Iron Attachment; Mary Hopper, San Diego, Cal. App. filed Dec. 29, 1916. Holding the electric wires out of the way of the operator.

1,236,309. Dynamo-Electric Machine; Louis F. Johnson, San Gabriel, Cal. App. filed May 19, 1913. Rotor is entirely free from winding, insulated bars, or electrical fittings of any kind.

1,236,341. Gin Brush; Stephen D. Murray, Dallas, Tex. App. filed Sept. 5, 1914. Improvements.

1,236,357. Electromagnet Construction; Henry E. Reeve, New York, N. Y. App. filed April 8, 1911. Forming each head of the magnet of a washer or disk of suitable metal, preferably such as brass, and having a central opening to receive the core.

1,236,375. Relay; Arthur H. Johnson, Epsom, England. App. filed June 4, 1914. Improvements.

1,236,379. High-Potential Switch; Granville E. Palmer, Brookline, Mass. App. filed Feb. 16, 1917. Contact members and thermal cut-outs or fuses are immersed in a non-conducting medium.

1,236,385. Rectifier System; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Feb. 5, 1914. Danger of injury to the apparatus by reason of short-circuiting within the rectifier will be avoided.